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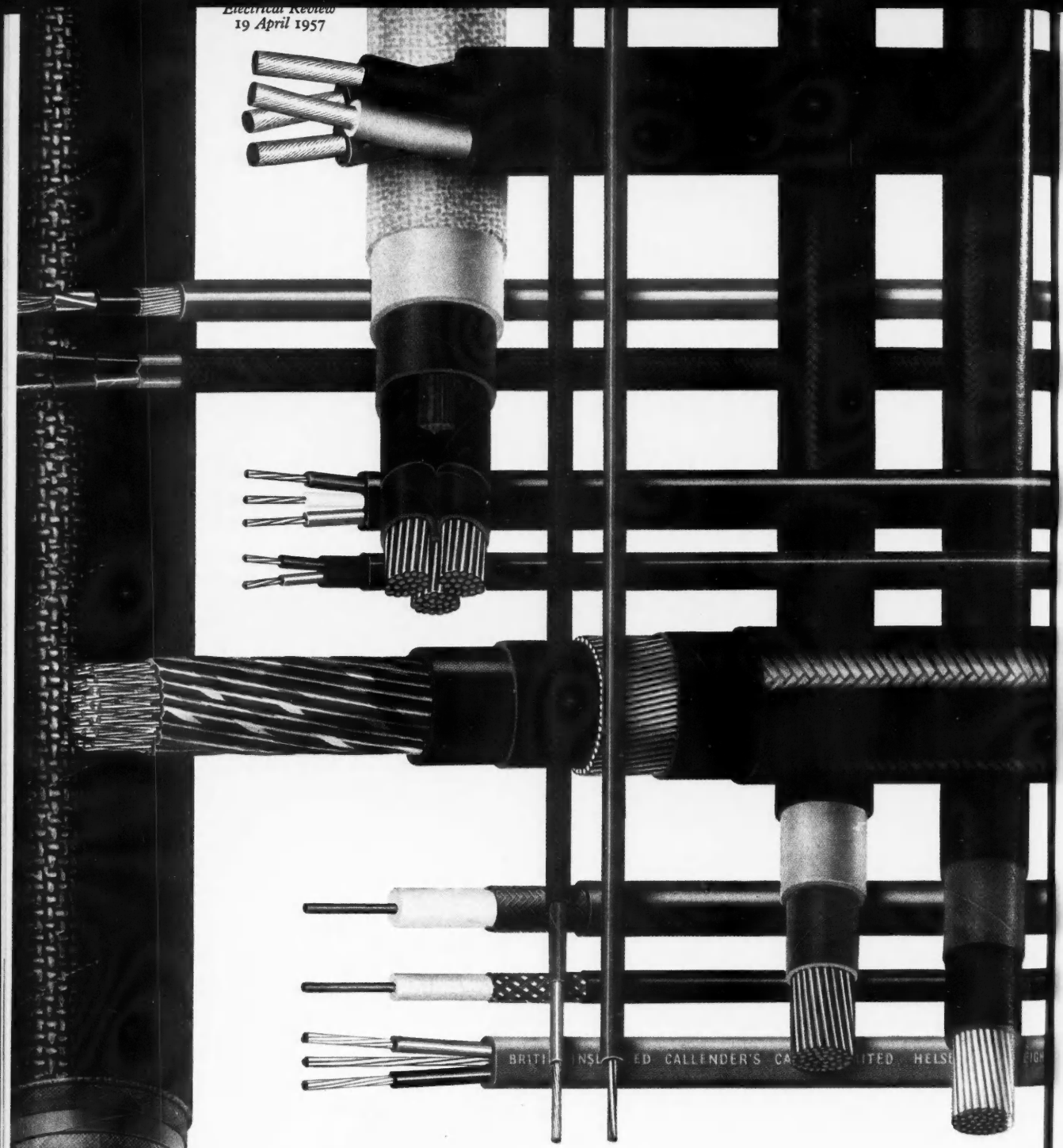
ELECTRICAL REVIEW



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1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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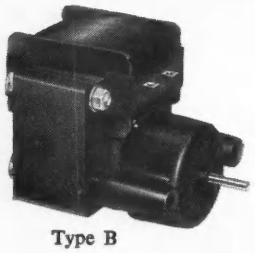

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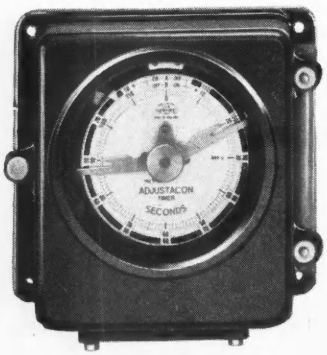

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ELECTRICAL REVIEW

19 April 1957 Vol. 160 No. 16 Established 1872

Nuclear Power in Britain

AT the recent information conference on nuclear energy for management, which was arranged by the Organisation for European Economic Co-operation in Paris, the delegates were left in no doubt as to which country was leading the world in the development and exploitation of nuclear energy for the generation of electrical power. All of the British papers received a great reception and it became obvious that the prestige of the British nuclear power industry was very high indeed.

We have not got into this position by accident. We aim to double our standard of living during the next twenty-five years and are looking to nuclear energy to help to fill the gap between our supplies of " fossil " fuel and our total energy demands. However, despite the assistance we can expect from nuclear energy we will still be obliged to import increasing quantities of fuel, particularly oil, for a very long time. The installed capacity of generating plant was 20,700 MW at the end of 1954 and is expected to reach 39,000 MW by the end of 1965. By this time we expect to have between 5,000 and 6,000 MW of nuclear plant in service thereby saving 18 million tons of coal annually. This programme will cost about £919 million including the initial uranium stocks, but a further £70 million should be added to this figure for expenditure by the Atomic Energy Authority on chemical processing facilities and prototype reactors.

The bulk of nuclear power plant installed by 1965 will be of the Calder Hall type but very much improved. Other reactor systems are being studied and some of these may be in operation before 1965 although the development programme must look beyond this date. However, the Calder Hall type reactor has assumed an established position in the British nuclear power programme and it is becoming increasingly evident that it has a very large development potential. There is a prospect of raising steam temperatures by further exploitation of magnesium alloy for canning fuel elements and by the introduction of beryllium canning. This will give better thermal efficiencies which are already as high as 28 per cent. Improvements in design of the reactor components will lead to lower capital costs and the expenditure per kilowatt installed will be reduced by further increases in the output of individual reactors.

Developing a breeder system is the ultimate goal of our nuclear power programme and here a safe and economic system is essential. A fast breeder reactor is being built at Dounreay in Scotland and will be in operation by 1958. The initial charge will be enriched with U235 and when by-product plutonium becomes available, development will switch to studying fuel elements enriched by plutonium instead of U235. Successful

operation of the fast breeder reactor may lead to the achievement of a 30 per cent fuel burn-up. If the Dounreay experiment is fully successful a prototype will be built in the mid 1960's when plutonium will be becoming abundantly available from the operation of Calder Hall type installations.

RELIEF DENIED

Announcing a reduction in purchase tax on a wide range of household goods in his Budget statement last week, Mr. Thorneycroft said that this would not only be welcomed by consumers but would also be of help to a number of British industries affected. Unfortunately the electrical domestic appliance industry will not be one of them, for despite repeated arguments and appeals the Chancellor specifically excluded electrical and gas appliances.

As the B.E.A.M.A. annual report (reviewed in our last issue) showed, the " lighter " side of the electrical industry suffered a decline last year because of Government restrictions. It had every reason to hope that this time there would be some relief from the anomalous burden which electrical household equipment bears. Purchase tax is operated in a strange way with little discrimination between luxuries and necessities, in which latter class many electrical appliances must now be included.

INVESTMENT ALLOWANCES

One of the points made by the Federation of British Industries in its pre-Budget representations to the Chancellor of the Exchequer was that investment allowances in respect of the replacement of fixed assets should be restored and the rates of allowance increased. These allowances were withdrawn in all but certain special cases last year. In the event the Chancellor has decided to favour the shipbuilding industry only in this way, by raising the investment allowance which it already receives from 20 to 40 per cent.

Other F.B.I. suggestions which the Chancellor has not acted upon relate to profits tax, depreciation allowances for commercial buildings and retirement benefit schemes. One matter has received attention, however; British-controlled companies operating solely in overseas countries are to be relieved of profits tax and income tax on their trading profits earned abroad, although dividends remitted to this country will still be subject to tax.

HEAT TREATMENT ADVANCE

Last January we commented on the very little, if any, headway which had been made over many years in the development of electric heating, particularly with regard to heat treatment. It appeared that the limit to operating temperatures in the case of metallic elements for 20 years or more had been about 1,200 deg C, while the limit for non-metallic elements had been 1,400 deg C. Now we hear of operating temperatures as high as 3,000 deg C, and in this issue there is a description of a range of furnaces developed by the General Electric Co., Ltd., capable of operating at this temperature.

Because of this tremendous advance we have sought an explanation from the company's Research Laboratories at Wembley. The development appears to be mainly due to the operation of the elements in a vacuum. These elements are of graphite material which would normally melt at such a high temperature in air or other gases, while in a vacuum they remain stable. Thus the answer to the long-standing problem of how to get higher temperatures for heat treatment appears to be the vacuum furnace, and the delay in the introduction of this lies in the fact that hitherto it has not been possible to provide sufficiently large pumps to create the necessary vacuum in the furnaces.

CONVENTION EXHIBITION

By its decision that its members will be unable to support an exhibition at next year's British Electrical Power Convention the British Electrical and Allied Manufacturers' Association has virtually made the holding of such an exhibition impossible. Without the participation of B.E.A.M.A. members any display would be of negligible proportions. The Association's decision was made because of its members' commitments in respect of the International Exhibiton to be held in Brussels next year. It is important that the British electrical industry's representation in this exhibition should be the best possible and that could not be if too much money and effort were required elsewhere. This does not mean, of course, that B.E.A.M.A. will not continue its support of the Electrical Engineers' Exhibition which has proved of value to its members.

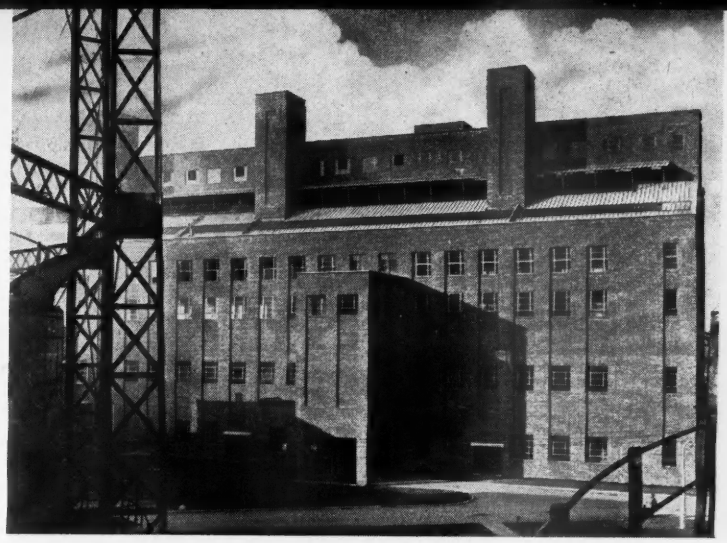
B.E.A.M.A.'s decision will deprive the Power Convention of a useful and attractive feature and it is to be hoped that there will be an exhibition at the 1959 Convention. Apart from Brussels, however, there had been some doubt whether exhibitors were getting the attention from Convention delegates that their enterprise deserved. In its last annual report the B.E.A.M.A. made it clear that it expected the Central Electricity Authority and Area Boards, as the principal customers, to ensure a better attendance of their representatives.

ELECTRICAL EXPENDITURE

A White Paper issued last week and dealt with on page 725 shows that of the approved expenditure by the national fuel and power boards for 1957 totalling £440 million, £274 million is required by the electricity authorities. This represents an increase of 12 per cent over the estimated expenditure for 1956. Expenditure in respect of nuclear power stations is now appearing and in 1957-58 the Central Electricity Authority will require £12 million for this purpose; the South of Scotland Electricity Board is also expecting to incur a small expenditure under this head.

An appendix to the White Paper shows that the net additional cost of substituting nuclear power stations for " conventional " ones will be £750 million up to the end of 1965, including £105 million spent on stations to go into commission after that date. The cost of the initial fuel charge for the stations (£190 million) is regarded as capital expenditure and is therefore included in the total.

POWER FOR GAS PRODUCTION

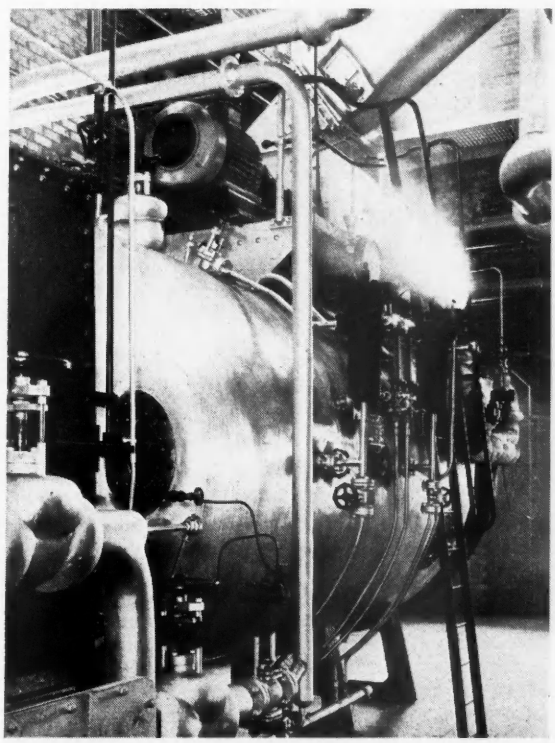


New All-Electric Establishment at Exeter

AS part of the integration policy of the South Western Gas Board it was decided to concentrate gas manufacture at some 12 to 15 stations instead of at over one hundred plants of varying sizes throughout the area. The selected base load stations are situated at the main centres of load and to achieve this many works were taken out of commission and at others major reconstruction programmes had to be undertaken.

One of the more recent examples of reconstruction is at Exeter, where a completely new manufacturing station has been built on the site of a plant which originally started gas production about a hundred years ago. This works should be of particular interest to our readers since every item of plant, contrary to previous gas works practice, is completely electrically driven and the whole of the power requirements are derived from steam generated in waste heat boilers in the coal carbonising plant. The steam is conveyed at 240 lb/sq in and 624 deg F to the adjacent power house where a 750 kW pass-out condensing turbo-alternator is installed.

Above : A general view of the new coal carbonisation plant of the South Western Gas Board at Exeter. Below : One of the three Ruston & Hornsby 7,500 lb/hr waste heat boilers



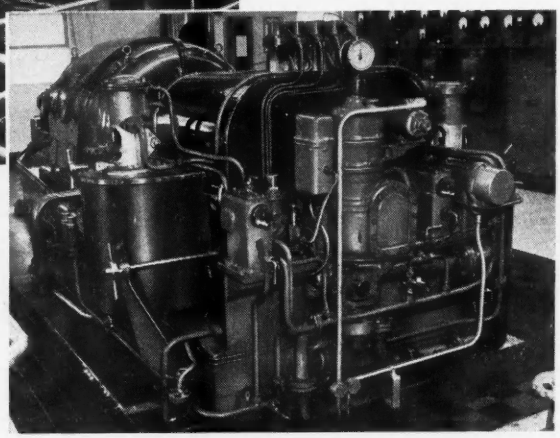
The reconstruction work at Exeter involved a variety of problems since portions of the old plant had to be demolished to make way for the new and at the same time continuity of gas production had to be maintained. Work commenced in the summer of 1952 and the completed plant was commissioned in July, 1956. At present the new works has a capacity of six million cu ft of gas per day with a calorific value of 470 B.Th.U/cu ft and also 240 tons of domestic coke and other by-products such as tar, ammonia, etc. Ultimately, the carbonising plant will be extended to have an output of nine million cu ft/day, all auxiliary plant having been designed for this capacity. The additional waste heat boilers will then permit of the installation of a further 750 kW pass-out condensing turbo-alternator set in the power house.

For the benefit of those readers who are not familiar with the processes involved in the production of gas, the basic principles are as follows:—Suitable coals are fed into the plant by means of wagon tippler and belt conveyors where they are passed continuously through vertical retorts constructed of silica brick. These retorts are heated externally by producer gas which is burnt in a system of flues, the producer gas being derived from the controlled combustion of coke in external furnaces. This process, which is known as carbonisation, produces coke which is extracted continuously from the bases of the retorts, the gas being drawn off from the top by electrically driven exhausters which also pump the crude gas through the purification plant for the removal of tar, ammonia and other impurities. The temperature needed for the carbonisation of the coal makes it inevitable that a large quantity of usable heat is left in the products of combustion of the producer gas. These waste gases are drawn through induced draught waste heat boilers to produce steam which is conventionally used for process and small prime movers. The main contractors for the coal carbonising and steam raising plant were the Woodall-Duckham Co., Ltd.

At Exeter, the three 7,500 lb/hr Ruston & Hornsby waste heat boilers are arranged to feed steam to the turbine in the power house, one boiler acting as standby. Ultimately, there will be four boilers, one of which will be a standby unit when the capacity of the plant is

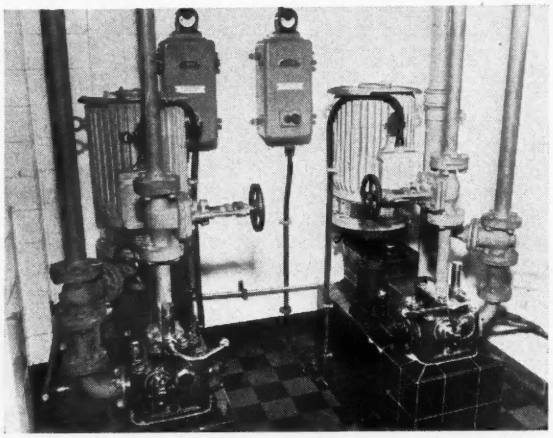
Left: Turbine floor of the power house which also accommodates all the major electrical switchgear and transformers

Below: W. H. Allen turbine showing the steam control gear



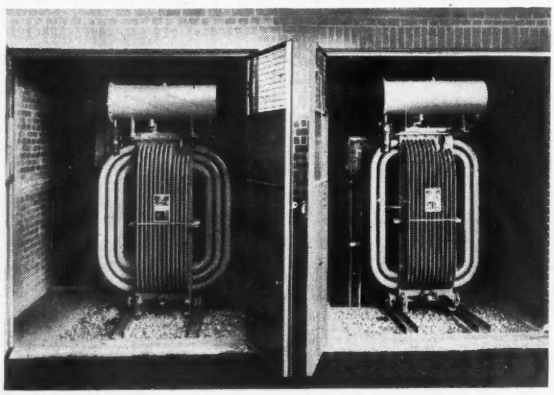
increased to nine million cu ft/day. Each boiler is of the horizontal fire-tube type and is equipped with a constant speed induced draught fan driven by an L.D.C. gas works type 25 h.p. 960 r.p.m. 415 V three-phase induction motor arranged for direct-on-line starting. For each boiler there is a two-stage Weir reciprocating type feed pump driven by a 7·5 h.p. 1,460 r.p.m. 415 V vertical spindle induction motor. Under normal conditions only two pumps are in service, the third unit acting as standby.

The power house is situated adjacent to the main gas carbonisation plant and it accommodates all the main electrical switchgear, transformers, and generating plant. Space has been provided for the second 750 kW generating set to which reference has already been made.



Two electrically driven feed pumps are installed, one of which acts as standby

One of the 1,000 kVA 6·6/3·3 kV transformers and one of the 750 kVA 3·3 kV/415 V units feeding the main l.v. switchboard



Generating Plant

The turbine is of the W. H. Allen multi-stage impulse condensing type running at 9,500 r.p.m. It is equipped with four automatically operated nozzle control valves and one hand valve to ensure maximum economy of steam at all loads and throttle flows. The control gear is of the Allen leverless oil relay leak-off type and oil is supplied by a governor oil pump relieved by a valve to ensure a pressure of 60 lb/sq in. The emergency valve is held open by this pressure, which can be destroyed by trip valves. The overspeed trip, which is of the eccentric ring type, and loss of pressure in the relays closes the emergency, throttle and pass-through valves.

The centrifugal speed governor can be controlled either by hand or by an electric motor arranged for remote control. A pilot valve for the automatic nozzle valves is operated by an oil relay connected to the throttle valve relay. The automatic nozzle valves are opened by a spring on a falling oil pressure, thereby ensuring that all the valves open whenever the set is shut down, thus avoiding the sticking commonly experienced on nozzle control valves.

The turbine pass-through valve is controlled by a pass-out pressure regulator. A pilot valve in the regulator is coupled to a floating dashpot and this controls the oil supply to and leak-off from the servo-motor operating the pass-through valve. This relay is interlinked with the throttle valve oil relay, thereby ensuring that variations in load do not sensibly affect the pass-out pressure. The valve, which is surmounted by the servo-motor piston and cylinder, is contained in a separate chest situated on the side of the turbine cylinder. On each pressure regulator there is an adjusting handwheel to enable the inlet or

pass-out pressure to be adjusted within fairly wide limits. Part of the steam from the turbine is passed out at 20 lb/sq in to the carbonising plant and as process steam, while the remainder is condensed.

The condenser operates with a vacuum of 28in Hg, and is capable, if required, of handling the full output of steam from the turbine. It has a total cooling surface of 1,068 sq ft and a cooling water requirement of 1,020 gal/min at 75 deg F. Outside the power house are three forced draught cooling towers supplied by Film Cooling Towers, Ltd. One of these receives water from the condenser at 95 deg F and cools it to 75 deg F. It is then pumped from the pond beneath the tower by means of Pulsometer pumps back to the condenser. The other two cooling towers are associated with the coal carbonising plant.

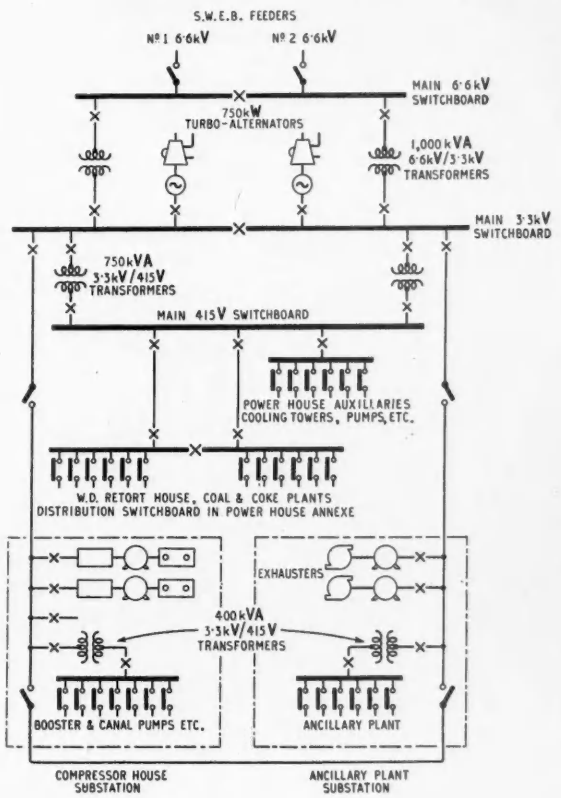
An electric load limiting device is provided on the turbine to over-ride the inlet pressure regulator to prevent more than full load being generated when running in parallel with the public supply, should an abnormal steam flow to the condenser result from a sudden reduction in pass-out demand. Current transformers inserted in the main alternator cables are connected via a selenium rectifier to a control coil, which operates a pilot valve interposed in the governor relay oil system between the inlet pressure regulator pilot valve and the main steam throttle valve relay cylinder. Under normal electrical load conditions the oil can pass this pilot valve freely, but if the alternator output current exceeds the full load or other predetermined figure, the control coil moves the pilot valve downwards to reduce the pressure in the throttle valve relay cylinder, which tends to close the valve, thus restricting the steam flow.

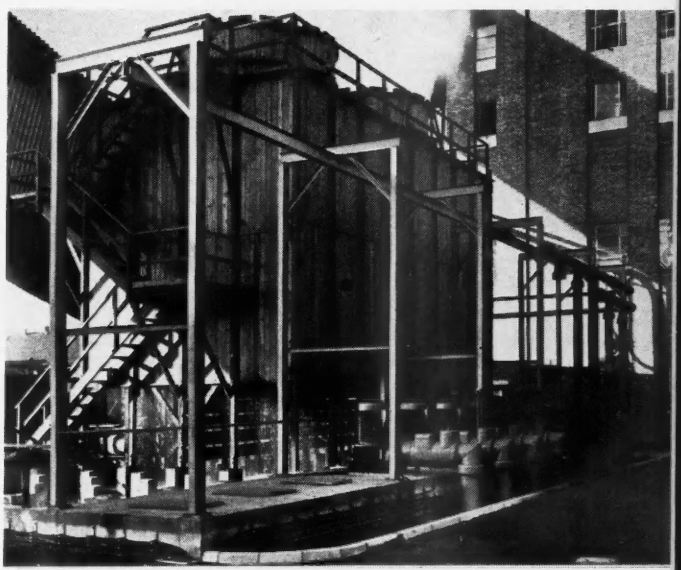
The turbine is equipped with three separate oil pumps, two being of the valveless gear type, driven in tandem off the lower end of the governor shaft. One pump delivers oil at 50/60 lb/sq in gauge to the governor oil system, while the other delivers oil at 10/15 lb/sq in gauge for bearing and gear teeth lubrication. The third pump is an auxiliary for use when starting up and shutting down, and is of the centrifugal type driven by a small steam turbine.

The air-cooled L.D.C. alternator is gear driven at 1,500 r.p.m. and is continuously rated at 750 kW, 3·3 kV, 0·8 p.f., three-phase, 50 c/s. The air coolers are of the closed circuit type, and are supplied with cooling water from the condenser circulating water system.

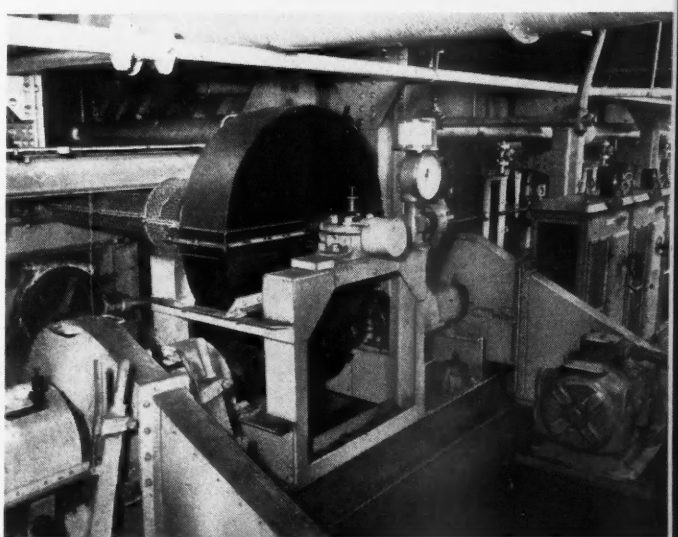
The automatic voltage regulator is of the Metropolitan-Vickers vibrating contact pattern. It is quick acting and maintains the alternator voltage within ±1 per cent from no load to full load. Provision has been made in the

Schematic diagram of electrical distribution system in Exeter Gas Works

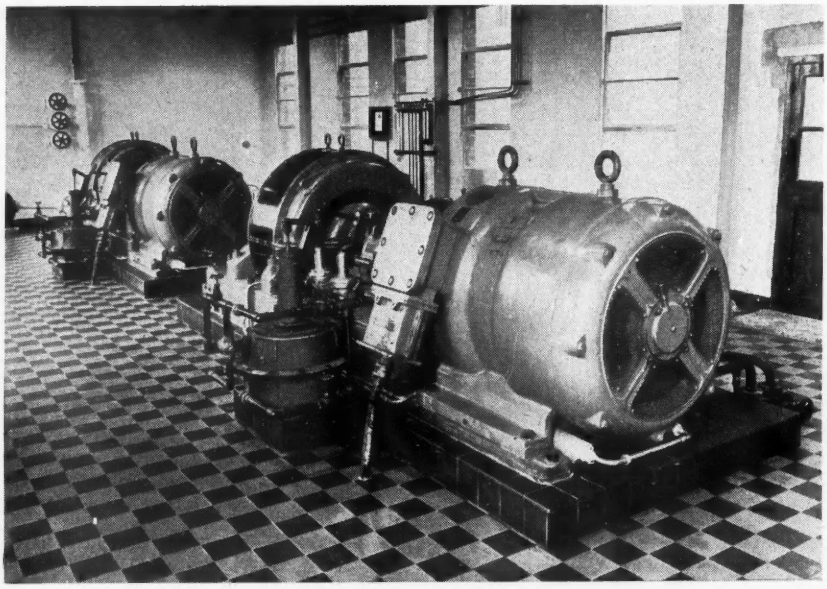




Three forced draught cooling towers cater for the power house and carbonising plant



Variable speed coke conveyor drive in the carbonisation plant



Gas is removed from the retort by two 120 h.p. FLP electrically driven exhausters

foundation block of the turbo-alternator to accommodate the seven current transformers associated with the alternator Merz-Price protection, the load-limiting device, and power factor compensating coils of the automatic voltage regulators.

The alternator is connected to the main 3·3 kV switchboard, which is at operating floor level in the power house. The oil circuit-breakers on this board are of the spring closing, solenoid release type except for the substation transformer switches which are straightforward spring closing. Altogether, there are six transformers, two 1,000 kVA 6·6/3·3 kV, two 750 kVA 3·3 kV/415 V, and two 400 kVA 3·3 kV/415 V transformers. All were supplied by Foster Transformers, Ltd. The main oil-immersed switchgear for all three voltages was supplied by George Ellison, Ltd., while the Lancashire Dynamo Group provided all the air-break fuse units and distribution boards.

To limit the imported maximum demand, facilities have been provided to trip automatically supplies to non-essential services. For synchronising the alternator with either of the 6·6 kV supplies duplicated from the S.W.E.B. a check synchronising relay has been incorporated in the main 3·3 kV switchboard. This is equipped with a normally locked defeat switch which, if required, may be used to by-pass the relay.

The main 11-panel 3·3 kV switchboard controls the main 1,000 kVA transformers, the present and future turbo-alternators, local distribution 750 kVA transformers and the two ends of the "normally open" 3·3 kV ring main to the ancillary plant and compressor house substations. The switchboard is in two sections coupled by a bus section switch. All circuit-breakers, of the truck-mounted type, are equipped with PBO relays giving over-current and earth-fault protection. Two of the Ellison e.h.v. circuit-breakers in the ancillary plant substation are solenoid operated and serve as stator switches for the 120 h.p. e.h.v. Flameproof Group 3 direct-on-line exhauster motors, operation being by FLP "start" and "stop" push-buttons adjacent to the exhausters.

The new works power house was designed by the Gas Board and constructed by the Woodall-Duckham Construction Co., Ltd. The main contractors responsible for the electrical equipment in the power house were the Lancashire Dynamo Group, who also supplied all the electric motors for the carbonising plant. All the electric motors installed in the works comply with the South Western Gas Board's specification; machines up to 7½ h.p. are of the totally enclosed gas works type; from 12½ h.p. to 40 h.p. the motors are enclosed "Fankuld" with gas works features. Other special motors include the 120 h.p. 3·3 kV Buxton certified flameproof squirrel cage induction motors, "Corcooled" for the exhausters and 210 h.p. 3·3 kV push-button operated slip-ring pressurised induction motors with separately driven flameproof fan units for the compressor drives.

All the motor starters are of the Brookhirst direct-on-line type and the oil-immersed switchgear was supplied by George Ellison, Ltd. The main Ellison switchboards, which are equipped with earth-leakage protection, and all the air-break h.r.c. switch-fuse units were supplied by the L.D.C. Group.

The total connected load is 1,500 kW and the power distribution has been carried out in multi-core cables of either v.i.r. lead-covered or p.i.l.c.s.w.a. types; conduit and v.i.r. were used only for lighting circuits, aluminium sheathed v.i.r. being used for control circuits. In order to avoid the necessity of carrying large quantities of spares at each station and to assist interchangeability of plant, the South Western Gas Board have standard specifications for switchgear, motor starters, motor frame sizes and speeds.

Acknowledgment is due to the South Western Gas Board for permission to publish this article.

BOOKS RECEIVED

The General Theory of Electrical Machines. By Bernard Adkins, M.A., M.I.E.E. Pp. 236; figs. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 45s.

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Silicone Insulated Motors

Review of Construction and Performance

By J. H. DAVIS, A.M.I.E.E.*

FURTHER progress in motor design depends largely on the use made of the newer synthetic insulating materials which have been produced and improved in recent years by the joint efforts of chemists and engineers. The trend is always towards a reduction in size for a given output, and the special requirements of such machines as aircraft motors have placed emphasis on this.

The majority of machines are insulated entirely with organic insulating materials, often in combination with mica splittings, and for most applications their performance is quite satisfactory, but they cannot be operated much above 100 deg C for very long without serious deterioration occurring. A smaller proportion of machines is constructed with glasscloth or asbestos combined with mica as basic insulation, but here again the bonding and impregnating resins limit the permissible operating temperature and thus impose limitations for some applications and restrict further design improvements.

The principal insulation, Classes A and B, are described in several British Standards including B.S. 2613: 1955,[1] but for some time it has been appreciated that the respective temperature limits of 105 deg C and 130 deg C make no allowance for the superior performance of the new synthetic materials, and the International Electrotechnical Commission have consequently recommended the following extension which is now incorporated in the British Standard[2] for the Temperature Classification of Insulating Materials, as shown in Table I.

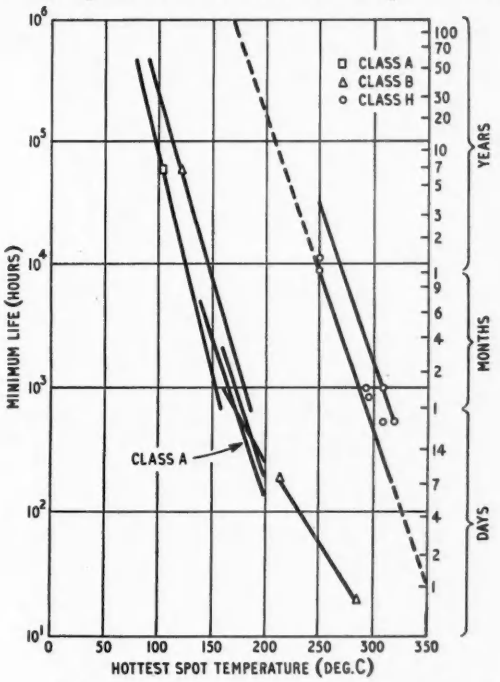


Fig. 1.—Composite thermal endurance curve (minimum life) for various classes of insulation as reported by several investigators

The introduction of Class H has been made possible by the development during the war years and subsequent commercial manufacture of silicone resins, which replace the organic bonding and impregnating resins used in Class B systems, and silicone elastomers which are unique rubber-like and heat resisting materials that may be used unsupported or backed by such materials as glasscloth.

It is now twelve years since the first experimental silicone insulated motors were constructed, as part of an accelerated life test programme to determine the permissible continuous operating temperature of this new type of insulation.[3] Two of the original test machines are still running after twelve years at 240 deg C, with periodic subjection to high humidity, and a considerable number of confirmatory tests and field experience have shown

Table I.—Temperature Classification of Insulating Materials

Class	Temperature Limit °C
Y	90
A	105
E	120
B	130
F	155
H	180
C	Above 180

that at 180 deg C a life at least equal to that of a Class A insulated machine at 105 deg C or a Class B machine at 130 deg C can be expected. The comparative life of these different insulation Classes is shown in Fig. 1.[4] In fact, the superior thermal stability of some of the more recently developed silicones is recognised by their inclusion in a subsidiary clause of Class C which they share with polytetrafluoroethylene. A little lower down the scale, silicones modified with additional organic groups to vary their physical properties will find application in Class F, and even in Class B, as wire enamels and impregnating varnishes. In these classes they may be used in conjunction with or as alternatives to polyester and epoxy resins and other organic materials.

Variety of Materials

A wide range of silicones is available to meet the requirements of the motor designer, and in combination with glasscloth, asbestos and mica they are supplied by most leading insulation manufacturers. Silicone resin bonded micanite is very suitable for slot liners and as armature bar insulation. Another useful material for this application is glasscloth bonded to asbestos with silicone resins, which retains good electric strength after bending with the asbestos in compression. Mica mat, made from exfoliated mica bonded with silicone resin, and used with or without a glasscloth backing, is popular in the United States and has been standardised by one large electrical

* Midland Silicones, Ltd.

organisation for certain traction motor insulation components. It is, however, much less suitable than glasscloth backed mica flakes for armature bars where severe centrifugal forces must be withstood, and is therefore restricted to other sections of the insulation.

Glasscloth coated with silicone resins has a high initial dielectric strength, but suffers from the disadvantage common to all varnished glasscloth of susceptibility to damage of the varnish film after creasing, which greatly reduces the permissible working voltage.

Silicone resin bonded glass laminates are the most suitable materials for slot wedge construction and are characterised by excellent dielectric and mechanical properties. They can be readily machined and withstand repeated heat cycling, without shrinkage or delamination, to a much greater extent than organic bonded laminates.

Impregnating varnishes consist of silicone resins dissolved in aromatic solvents and an important feature of their application is that higher than usual curing temperatures must be used. The recommended curing cycle for MS997 varnish, for example, consists of a pre-bake at 200 deg C to remove all moisture and more fully cure the Class H insulation components. After cooling to about 70 deg C the winding is dipped and then drained in air before curing at 200 deg C for about two hours. After cooling to room temperature a second dip is given, and after draining a final bake of several hours at 200 deg C to 250 deg C completes the cure to the required degree. Fuller recommendations are given in appropriate data sheets, which should be followed as closely as possible.

It is important, of course, to ensure that all previous organic insulation such as baked varnish residue is removed from a rotor or stator prior to a Class H re-wind, both to avoid contamination of the silicone varnish dip tank and to ensure that the performance of the completed machine is not impaired.

Silicone Elastomers

These very useful materials combine the elastic properties and appearance of natural rubbers with the characteristic resistance of silicones to high and low temperatures. For machine insulation they are at present generally supplied as tapes with a glasscloth backing or as pastes for void filling or adhesives.

Two principal forms of glasscloth supported tape are available. The first is supplied fully cured, and is generally made by impregnating the glasscloth in a dispersion of the elastomer and curing in a coating tower. The resultant product, which can be based on either straight or bias cut glasscloth, is characterised by a high electric strength which is retained after repeated flexing, a feature which is not obtainable in any form of varnished glasscloth. On the other hand, these tapes are rather more expensive than the silicone varnished glasscloth variety, and less flame resistant. They will comply fully with Class H requirements.

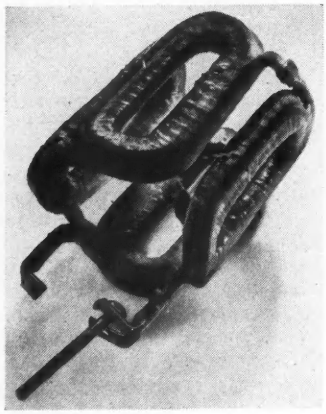


Fig. 2.—Field coil assembly from the 24 V, 1·75 h.p., 12,000 r.p.m. 10 min rating airscrew feathering pump motor of a Fairey "Gannet." It weighs 11½ lb and is silicone insulated and impregnated with silicone varnish. (Courtesy Rotol)

The second form of tape is supplied in semi-cured form and, after being taped into place and overlapping with a temporary glasscloth or cellophane tape to maintain pressure, the elastomer is cured by a short bake at about 150 deg C. The principal advantage over the first type is that no additional adhesive is required, but against this must be set the fact that the somewhat soft semi-cured coating is rather liable to damage when taping round sharp corners. None the less, this form of tape can be used effectively as an outer wrap for armature bar insulation, and, for example, London Transport Executive has made considerable use of it in rewinding Metadyne generator armatures. A more recent development is a fully cured tape which carries an additional semi-cured coating. This appears to combine the advantages of both forms described.

Recent newcomers are the silicone pressure sensitive adhesives, which will adhere to virtually any material including even polytetrafluoroethylene. This is in direct opposition to the usual silicone characteristic of non-adhesion, which finds wide application for silicone release agents in moulding processes. The silicone pressure sensitive adhesives retain their bond for some time at 250 deg C, and continuously at lower temperatures, and may therefore find application as both permanent and temporary bonds in machine construction.

In Tables II and III the relevant electrical properties of a selection of silicone insulating materials are given.

Class H Machines

While considering further the ways in which these insulating materials have been used to date in machine construction, and the possible future developments which they may make possible, it is desirable to describe the conditions which call for a Class H motor. In general, the aim will be to achieve one or more of the following objects: a high ratio of power to weight or space, high overload capacity, operation at high ambient temperatures, high insulation reliability, elimination of fire risks, and resistance to water and water vapour.

A high power to weight and space ratio is particularly important in aircraft motors, though the tendency towards lighter and smaller industrial equipment favours the wider application of such machines. An example is shown in Fig. 2. This type of aircraft feathering pump motor has now aggregated a considerable number of running hours on test and in service without any electrical failure being reported.

Many motors are subject to considerable load fluctuations, though peak loading may be of relatively short duration. To meet these conditions a Class A or B machine of sufficient capacity to withstand the recurrent overloads must be installed, and in consequence runs well below its rated output and efficiency for most of the time. In these circumstances it may well be worth installing a Class H machine which is designed for maximum efficiency under normal running conditions at, say, Class B temperatures. When heavy overloads occur the Class H machine can take them in its stride because of the thermal endurance of its insulation.

There are many industrial applications where motors must be mounted in close proximity to furnaces, ovens or other sources of heat. Class H machines are particularly well suited to this type of work and repeated insulation failure has often been prevented in these circumstances by a Class H rewind.

The loss incurred by insulation failure must be reckoned not only in terms of the rewind cost; in the

chemical process industries and on continuous production lines it is often particularly desirable to avoid any hold up by ensuring the maximum reliability of the machine insulation. Fig. 3 shows a stage in the construction of a consignment of silicone insulated induction motors for Canada, built to fulfil these requirements.

A further important field is related to nuclear energy power generation where auxiliary motors must operate without failure for several years before any overhaul can be carried out, and in this case it is often necessary that the insulation should not seriously deteriorate under irradiation. Tests on silicones have shown that some types are outstandingly good in this respect and a programme is at present in hand to obtain more detailed information. The general tendency of nuclear radiation is to increase molecular cross linking in organic materials, which often leads to embrittlement, but this tendency is so much less in the case of certain silicone laminating resins, for example, that it was not found possible to polymerise them completely by nuclear pile irradiation. In view of these properties it is probable that silicones will find extensive application in the insulation of auxiliary plant for nuclear energy power stations.

Table II.—Comparison of Silicone Bonded Laminates with Resin Bonded Laminates, the Test Figures being obtained on $\frac{1}{8}$in Laminates. *(Courtesy Ashdowns, Ltd.)*

Property	Phenolic	Melamine	Silicone
Power factor at 1 Mc/s B.S.1137	0·06	0·08	0·002
Electric strength (V/mil) B.S.1137	150–200	150–200	250–300
Laminae breakdown (kV/in) B.S.1137	15–20	10–15	50
Insulation resistance(Megohms) B.S.1137			
(1) Dry	10,000	20,000	500,000
(2) After immersion in water for 24 hours at 20° C	10	10	10,000
Water absorption, mgm B.S.1137	40	20	5–10
Tensile strength, lb/sq in B.S. 1137	20–25,000	20–25,000	15–20,000
Shear strength, lb/sq in B.S.1137	20–25,000	15,000	14,000
Impact strength, ft/lb ($\frac{1}{2}$in. x $\frac{1}{2}$in. notched samples)			
(1) Flatwise	5·0	6·3	5·6
(2) Edgewise	2·0	1·8	2·0
Effective temperature resistance, °C	150	150	250

Table III.—Typical Electrical Properties of Silicone Insulating Materials

Electrical properties measured at 20° C	MS996 Varnished glasscloth Total thickness 7 mils	Silicone resin bonded glass/mica/glass Total thickness 15 mils	Silastomer 132 coated glasscloth tape Total thickness 8 mils
Electric Strength V/mil ($\frac{1}{4}$in dia. electrodes, instantaneous breakdown)			
(a) As prepared ..	1,900	1,000	1,150
(b) After 30 days' ageing at 250° C	1,700	900	1,000
(c) After creasing, following (b)	200	500	800
Permittivity at 50 c/s	3·4	3·9	3·8
Power factor at 50 c/s	0·01	0·03	0·01

* " Silastomer " is a registered trade mark of Midland Silicones, Ltd.

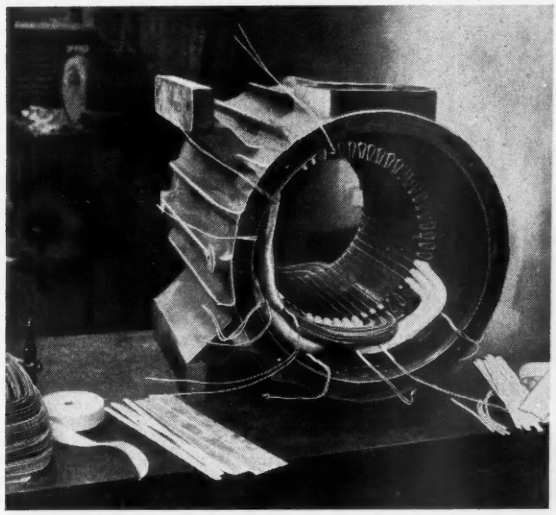


Fig. 3.—Part of an export consignment of 25 motors for Canada for which silicone insulation was specified to ensure longer life and greater reliability under arduous conditions. (Courtesy Lancashire Dynamo & Crypto, Ltd.)

The resistance of silicone resin bonded insulating materials to fire has been strikingly shown in tests to destruction of Class H and Class B motors. Following extensive heat ageing, with periodic humidification, the Class H machines eventually failed after the silicone resin on the glass served conductors had crazed sufficiently to admit air. Oxidation of the copper at the test temperatures of 260 deg C upwards progressively caused a hot-spot to develop until an open circuit failure occurred. Although the copper wire melted, only a small local residue of silica was formed and the motors did not catch fire. In contrast, the organic resin on the glass served wire of the Class B machines carbonised and caused a short circuit failure between adjacent turns, whereupon the motors burst into flames.

Resistance to water and water vapour is a common reason for choosing silicone insulation and it is important to consider the performance that can be expected. Silicone varnish films resist wetting very effectively, but are permeable to water vapour. For this reason a thin outer coating of silicone varnish on a Class A or Class B winding will improve the surface resistivity and prevent wetting by spray, but in a humid atmosphere the insulation resistance between conductors and earth will fall in the usual manner.

However, complete impregnation of a winding in silicone varnish—whether the underlying components are Class H or Class B (in which case the silicone varnish must be baked at a lower temperature than usual) produces a marked improvement. The insulation resistance still falls appreciably on immersion in water or exposure to high humidity, but the rate of fall is less than that of many organic varnish impregnated windings, and there is a fast recovery when drying out because the silicone resin does not retain any appreciable amount of absorbed moisture. Machines insulated with silicone materials have given very satisfactory service in damp conditions, partly because of their lower rate of fall in insulation resistance and partly because of the rapid recovery when drying out.

A number of coal cutter motors have been rewound in Class H materials for the National Coal Board, North Eastern and Durham Divisions, by British Electrical Repairs, Ltd., Newcastle-on-Tyne. These are operating

in pits under wet conditions where insulation failed frequently on the original Class B windings, and very promising results have been reported after service of up to two years.

Tests on some of these machines have shown that even where the insulation resistance at standstill has dropped as low as 10 kΩ or less under excessively wet conditions, the machines could be switched straight on without failure and rapidly recovered as they ran up to temperature. Under similar conditions Class B machines are likely to fail by short circuit, but the thermal stability and rapid drying out characteristics of the Class H motors seem to be responsible for this ability to withstand initial insulation leakage currents.

To achieve the maximum resistance to moisture ingress, silicone elastomers should be used as outer insulation. An armature bar half lap taped with Silastomer impregnated glasscloth, bonded with a Silastomer paste, retains its insulation resistance to a remarkable degree after exposure to humidity or immersion in water. Fig. 4 shows the relative performance of typical armature and test coils insulated by these several methods.

Mechanical Considerations

The main problem involved in ensuring successful motor performance at Class H temperatures has proved to be the design and lubrication of suitable bearings. Bearings specifically made for the higher operating temperature, which is usually about half the winding hot-spot temperature, should be used and if the bearing load is not very heavy a silicone lubricating grease will give satisfactory service over the full temperature range. MS41 lubricating grease, for example, retains its lubricating properties over the temperature range −30 deg C to +230 deg C while MS44 gives good service from −40 deg C to 200 deg C. However, silicone greases developed to date are poor under heavy loads and in such cases a high temperature lubricant such as the molybdenum sulphide type should be used.

No other serious mechanical difficulties have been encountered in impregnating and operating Class H machines. The steels used in rotor and stator construction seem to withstand curing temperatures as high as 250 deg C without deterioration, and it is interesting to note that in machines operated on life test for several years at this temperature no increase in iron losses occurred; the laminations were insulated with a mineral filler in an organic bond of the standard Class A or Class B type.[9]

The bond strength and hardness of silicone resins are good when cold and comparable with a good general purpose Class A varnish at 100 deg C, but are rather low at Class H temperatures. This should be borne in mind when designing some types of wound rotor for Class H machines but it does not seem to have caused any general difficulty so far. In fact, the relatively soft hot resin probably helps in ensuring long life for the machine because a harder and more brittle resin would craze under similar heat cycling conditions.

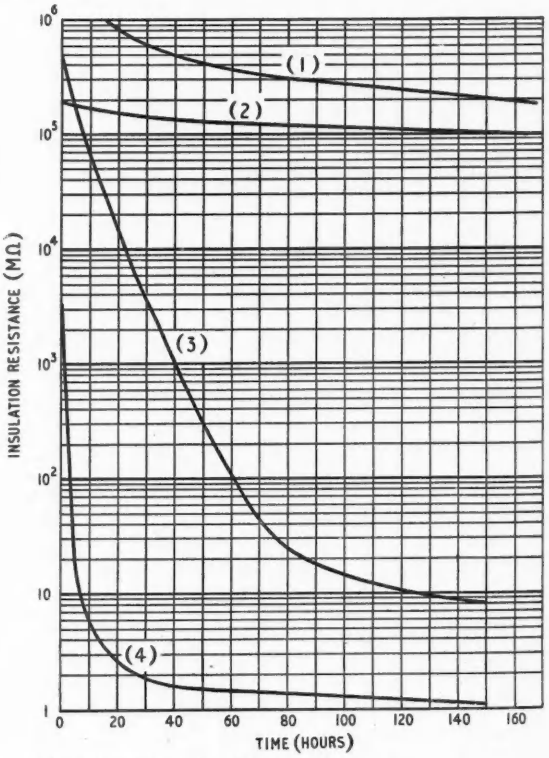
Early in the history of silicone insulation it was noted that an increase in brushwear occurred in totally enclosed machines. Laboratory tests confirmed this, and the trouble appeared to be due to the fact that the small amount of volatiles produced from the hot winding was decomposed in the brush contact arc leaving a thin film of abrasive silica.

Recent developments in connection with brush carbons and the use of special silicone impregnating varnishes which produce a negligible amount of volatiles have partially solved this problem, but a complete answer has not yet been found. However, there is no evidence of abnormal brushwear in ventilated machines.

Current and Future Developments

Apart from the replacement of organic insulating materials by silicones, most Class H insulated machines built so far show little or no difference in electrical design from their Class B counterparts. However, those which have been specifically designed to achieve a high power output in relation to size indicate the progress which is possible in this direction. An example is shown in Fig. 5 where a very considerable reduction in frame size has been made possible by using silicone insulating materials and silicone enamelled wire. In this case special attention has been paid to the magnetic circuit design and the operating temperature on full load is about 165 deg C. The efficiency is similar to that of a Class A insulated machine of equal output, but much larger frame size, and there is probably a worthwhile saving in total material cost.

The saving made possible by this type of design will probably be greatest on medium sized and larger machines, where insulation cost is a small proportion of the total and in the United States some larger Class H machines already cost no more than their Class A equivalents. Modified-silicone enamelled wire is a cheaper alternative to Class B varnished glass covered conductors, and may, therefore, be used to a considerable extent with both organic or silicone insulation components and impregnating varnishes in this temperature range and above. The field of combined organic and silicone insulation is worthy of further study, and an important relevant example is a type of railway traction motor produced in large numbers in the United States. This is partly insulated with organic



(1) Silastomer 132/glasscloth insulated conductor.
(2) Test coil filled with silicone elastomer paste.
(3) Similar test coil impregnated with MS997 silicone varnish.
(4) Similar test coil impregnated with oil modified phenolic varnish.

Fig. 4.—Insulation resistance/time characteristics for armature bars and test coils totally immersed in water

materials, but silicone elastomer/glass tapes are used as field coil insulation, providing a resilient and easily applied outer layer.

The silicone elastomers are likely to find many applications because of their unique properties. Mention has already been made of their resilience, retention of electric strength in tape form after heat ageing and flexing, and of their value in constructing waterproof insulation systems, but a further asset is their high thermal conductivity, which itself increases considerably as the temperature rises from 20 deg C to 200 deg C.

In fact, two test coils of similar construction, one varnish impregnated and the other filled with Silastomer 6-126, both operated at 150 deg C even though the Silastomer filled coil carried 25 per cent extra load. In this case the Silastomer 6-126 was applied as a paste during coil winding, but it is now possible to vacuum impregnate completed windings of fairly open structure in experimental silicone elastomers, and this process will be of interest in some motor applications because of the increased loading or reduction in temperature that will be made possible.

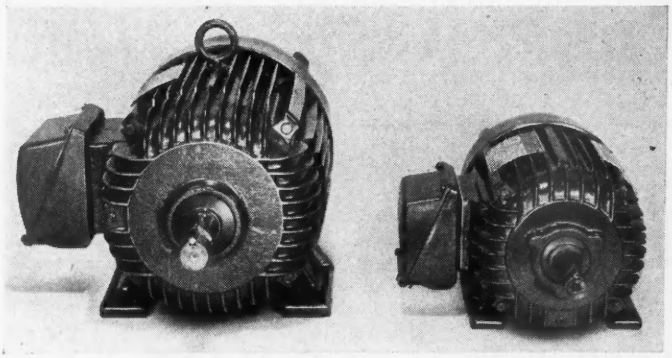


Fig. 5.—These motors are both continuously rated at 7½ h.p., the smaller being silicone insulated. By designing to take full advantage of silicone insulation a high power/weight ratio is achieved without loss of efficiency. (Courtesy Westinghouse Corporation)

The Allis Chalmers Corporation[15] has recently produced a range of open slot, Class H insulated, squirrel cage induction motors in which conventional slot and end winding insulation is replaced by a tough grade of silicone elastomer. The individual conductors are still covered with silicone varnished glass, and the silicone elastomer tape is then applied half-lap with silicone elastomer paste between layers. An outer wrap of glasscloth backed silicone elastomer is finally applied, and the whole consolidated by hot pressing.

The advantages of this type of insulation include high electric strength, due to the uniform permittivity and potential gradient, high thermal conductivity, water resistance and resilience. However, mica is unrivalled among insulating materials in resistance to mechanical as well as electrical stresses and for this reason is likely to continue to be preferred for rotor insulation. Further field experience and laboratory tests will help to define the limitations and possibilities of this new form of insulation.

The present situation, then, is that the designer is no longer limited by the thermal endurance of available insulating materials, and operating temperature limits are now determined by the machine bearings or other considerations. Silicones are relatively expensive, and though manufacturing developments in the next few years may enable some cost reduction to be achieved it is unlikely that it will be possible to compete in price with conventional organic insulating materials. For this reason it is improbable that silicones will become universal insulating materials for all and every motor made, but the possibility of achieving superior technical performance, or even an overall saving in total cost, by operating at or near the higher temperatures which silicones permit, is likely to produce interesting advances in design for quite a number of applications. Further, the special properties of silicone elastomers, silicone wire enamels and other modified silicones give them an important place at the new Class F temperature of 155 deg C, and even below, particularly where resistance to moisture is an important requirement.

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ELECTRONIC SORTING MACHINE

ON a visit to the Southampton Head Post Office recently the Postmaster General announced the placing of an order for twenty electronic letter sorting machines. This type of machine has been developed by the Post Office in its research laboratories at Dollis Hill. It is 16ft long, 2½ft wide and 6ft high, and weighs about two tons, although it can be moved to a new position and be working again within three hours. The machine is controlled partly mechanically and partly electronically. The operator sits at one end facing a window in which each letter is shown to him in turn. He has before him a keyboard with 24 keys—12 for each hand. In addition there are two special keys, one for cancelling wrong keying and the other for allowing letters to be sorted to an "unclassified" section. To sort a letter the operator merely depresses one of the 24 keys with each hand simultaneously, according to a combination which he has previously memorised. He does not have to follow any set rhythm and he can make his own speed, which is governed only by the time required to decipher the address and press the appropriate keys. The letter then disappears from his view and is conveyed on roller tracks, along rows of boxes, until it reaches and is diverted into its proper box by an electronically controlled "memory" device. Delivery of these machines is to begin in April, 1958.

Off-Peak Space Heating

Transportable Thermal Storage Heaters and Electrical Floor Warming

TWO papers exemplifying the use of the thermal storage principle for heating buildings were presented before the Utilisation Section of the Institution of Electrical Engineers yesterday (Thursday). One, by Mr. E. Bates (Eastern Electricity Board), described experiments that had led to the design and production in this country of automatically controlled transportable units for commercial and industrial premises which were in continuous use. Ideally, the heat-storage material, the author stated, should have high specific heat, low thermal conductivity and low specific weight. The blend of 55 per cent radiant and 45 per cent convected heat and the temperature difference of only about 3 deg F between floor level and ceiling was appreciated by users. An oven-type thermostat was not needed as a safety device because if the controlling arrangements failed in the closed position a stable temperature was reached of about 180 deg F for a 1 kW unit, which would be safe.

Higher loadings and storage capacity could be reached without a comparable increase in mass if a layer of heat insulation (e.g. fibreglass) were interposed between the storage blocks and the inner side of the case, but the author deprecated the use of surface temperatures of, say, 230 deg F with an eight-hour charge. Only four years after the experiments described in the paper at least four manufacturers were producing yearly some 20,000 transportable thermal-storage heaters.

Consumption and Heat Output

Particulars were tabulated of the heat output of a 1·5 kW heater during and following a maximum charge of eight hours by night only, any reliance on a mid-day boost being considered undesirable. Of the input of 12 kWh, one-third was emitted during charging, leaving 8 kWh for release during nine hours of occupation in which 4·97 kWh was supplied to the room. At the start of the latter period heat delivery was at a rate of 840 W, which fell to 340 W by the end. Heat released from the fabric into the occupied space was enough to balance the falling output of the heaters within 2½ deg F. As a rough guide a 1·5 kW heater should be installed for each kW of calculated heat loss.

Unless an attempt was made to divert the day-time heating demand it might well grow to unmanageable proportions, for not only was electric heating in accord with present-day desires and conditions, but the relative cost to the user had never been so much in favour of electricity. At present the field of development for transportable thermal storage heaters was restricted to commercial and industrial users, but as an indication of the trend he gave the following average of domestic fuel prices and wage levels in 1954, taking 1938 as 100: coal, 261; gas, 219; electricity, 110; and wages, 322.

Floor Warming Installations

The second paper, by Messrs. J. W. Moule and W. M. Stevenson (South of Scotland Electricity Board), dealt with electrical floor warming. Desirable features of space heating were stated as the transmission of warmth to the human body, mostly by radiation from uniformly warm surroundings, and the minimising of air movements. Usual convection heating systems were wasteful as necessitating higher temperatures (especially at ceiling level) than when radiant heat was present. For floor heating systems in Scotland, 73 deg F was taken as the maximum at the surface of the floor coverings. A minimum outside temperature of 28 deg F was usually allowed for, but in a few cases a figure as low as 20 deg had to be taken. The temperature of the floor was to some extent self-regulating, since the rate of heat emission varied with the internal temperature. Two types of regulator described were said to secure the minimum electricity consumption.

Two methods of installation were described. In one a heating cable or wire was buried solidly in a concrete floor. In the other, circular or D-shaped metal housings were incorporated in a concrete floor during building and heating cables were drawn in afterwards. The first kind was cheaper, but the concrete screed would have to be broken up to repair a faulty cable. Insulated or bare wires could be supplied from 240/25 V transformers; alternatively, cables finished with chemically inert p.v.c. or with metal sheathing not more than 3in apart and loaded at 2½ W/ft could be fed at mains voltage. A transformer-operated system involved a higher capital cost and the accommodation and noise of the transformer might present difficulties, but the cable was more robust. Two manufacturers had produced withdrawable systems, one in D-shaped housings from 6 to 12in apart and the other in round metal conduit. The usual tariff for floor warming in the Area provided for the disconnection of supply from 7 a.m. to 11 a.m. and from 3 p.m. to 7 p.m.

SOME OF THE FLOOR-WARMING INSTALLATIONS IN THE SOUTH OF SCOTLAND

Reference	Type of building	Floor area ft²	Volume ft³	Building heat loss B.Th.U./h	Loading in floors kW	Loading in walls and ceilings kW	Estimated annual consumption kWh	Average temperature rise °F	Capital cost of installation £	Estimated operating cost £
A	Industrial	24,000	365,000	975,060	284·07	2·25	406,000	32	5,170	1,070
B	School	42,200	496,425	1,300,000	389·77		650,000	30	11,550	2,750
C	Edinburgh Health Centre	30,500	258,000	870,000	232	30	393,000	35	9,645	1,500
D	School	24,120	265,000	662,190	215	3·35	337,500	27	8,812†	1,810†
E	School (stage I)	15,870	164,950	760,850	200	30	381,600	42	8,180	1,720
F	Public services (stage I)	9,405	96,680	304,110	78·58	22·08	180,000	32	13,420*	3,540
G	Fire station	6,276	61,500	238,000	68·25	0·75	110,000	32	1,910	458
H	School	84,900	910,000	2,750,000	860	—	1,290,000	35	23,500	3,760
I	Industrial	8,880	71,040	266,400	110	—	127,000	32	1,207	370
J	Industrial	83,000	788,500	3,000,000	880	—	1,320,000	32	24,550	3,850
K	Domestic	14,980‡	132,240‡	560,000	164	—	256,000	32	4,210	800
L	Domestic	10,630‡	79,740‡	510,000	148	—	250,000	32	3,950	780

* Costs for a total installation of 650 kW. † Costs include domestic hot-water supplies. ‡ Living room and hall only.

Opening the discussion, Mr. J. I. Bernard (E.D.A.) said that the papers showed clearly that thermal storage heating, by either of the methods described, was both practicable and controllable. There were, however, some pitfalls which should be avoided. First of all, buildings should have a reasonable amount of thermal insulation and builders were not easy to convince of this. Secondly, some insulation was needed around the edge of the heated floor slab to prevent heat from going sideways or underneath and causing undue heat loss in, for instance, a waterlogged subsoil. However, they were learning from experience and this was a simple and satisfactory method of filling the night valleys in electricity supply, particularly as the standing charge was likely to increase still further. It was reasonable in capital costs, could be very efficient and should enable all-electric houses to be supplied at a low-load factor.

Mr. S. L. M. Barlow emphasised the importance of proper design. Installations could rapidly fall into disrepute if the customer did not know beforehand exactly what he was buying. Because of the internal design the flat top had proved very convenient, and this created a fire hazard since material with a low fire resistance might be put there. More research should therefore be done on outward design. Again, some thermal storage heaters were very heavy, which made it difficult to clean out dust accumulating behind them. However, the most important point was that instead of being sold from a catalogue, they should be sold with technical "know-how" both to the customer and to the man selling them.

Mr. H. H. Bruce said that if intolerable waste of electricity was to be avoided, off-peak heating with uncontrollable release must often be limited to less than two-thirds of the space heating load. Uncontrolled release off-peak space heating with electricity sold at 80 per cent of the normal rate was very satisfactory for Electricity Boards but not for the consumer.

Mr. C. E. Mills (Phœnix Assurance Co.) said that as heaters were in use at night when premises were untenanted, a spreading fire could develop if trouble associated with them should occur. Secondly, since there was no red glowing element or pilot lamp, masking could occur, causing a rapid rise in temperature and igniting inflammable material. Thirdly, higher surface temperatures might occur during the night-time charging period and there was a deferred heating effect when masking might well produce dangerous conditions.

Mr. K. C. Jamieson pointed out that there were two entirely distinct methods of floor warming: one where no storage effect was required and a source of heat was always available, and one in which the storage capacity of the floor was employed to enable off-peak electrical heating to be used. Before heating engineers could use this method with confidence, they needed to know a great deal more about the behaviour of cooling floors and their effects on comfort and he would be glad to see such evidence produced.

Mr. W. Gilchrist (Merseyside and N. Wales E.B.) said the evidence of those using floor warming indicated clearly that from the comfort angle it was very satisfactory. Certain aspects of design and cost, however, required attention. There was no doubt in his own mind that floor warming was the forerunner of the all-electric domestic multi-storey building.

Mr. L. Shepherd said that in the short life of the development of block storage heaters there had been too much muddled thought about the installed load. Mr. Bates' figure of 50 per cent added to building heat loss was realistic if the aim was comfort temperatures of the order of 65 deg F. The type of control was important. With installations controlled basically by time, an installation designed on too small a heat input would always be short of heat because of the proportioning effect of the timing control.

Mr. P. H. Greer said it was not appreciated sufficiently how much heat a block storage heater could carry over. The statement that it had no overload capacity was quite wrong. Its overload capacity was in its stored energy. He described the means used to protect heaters against fire danger by a fusible link and changes in the shape of the heater.

Miss Miriam V. Griffith said that the E.R.A. had collaborated in extensive tests on floor-heated buildings in the last four years. She agreed with the statement about local variation in external ambient temperature which should be taken into account in designing systems, and said that a great deal of work was still required on methods of control. The present method of calculation of heat loss in estimating consumption or the required installed load needed more investigation.

Mr. R. B. Rowson (South Wales E.B.) emphasised that every effort should be made to get the purchase tax position altered as regards the domestic use of block heating. It would be appreciated that while a system of floor heating could be put into a new house, nothing could be done about existing houses.

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

A.C. Installations in Ships

I WOULD refer to the report in the *Electrical Review* of 29th March in connection with Mr. A. N. Savage's recent paper to the Institute of Marine Engineers concerning a.c. installations in ships.

The paper is both valuable and timely, and in calling attention to a specific point mentioned in your report I do not wish to detract from its general value. However, it would appear that the author is under some misapprehension concerning the capabilities of modern h.r.c. fuses. The figure of 33,000 A, which you quote from him as being the limit of short-circuit performance of fuses on d.c. applications, is merely a nominal figure which has been adopted in the current British Standard for fuses. My own company has carried out tests at much higher values than this. Prospective short-circuit currents in the region of 100,000 A at 220 V d.c. hold no terrors for our h.r.c. fuse designers, and should not present any problems to the user providing the correct fuses are used.

D.c. applications, whether industrial or marine, pose problems other than high prospective short-circuit currents. Operational and circuit conditions can vary enormously between one job and another. Fuses from our standard range of industrial non-deteriorating h.r.c. fuselinks are generally suitable for most ordinary industrial conditions, but where the application is in doubt my company is always willing to discuss the circumstances of any particular job on its own merits, and to advise on the correct fuse to apply.

A.c. performance of h.r.c. fuses is more widely known but it is germane to mention also that category A.C.5, corresponding to 35 MVA or 46,000 A (r.m.s. symmetrical) at 440 V, by no means represents the limits of even our standard range of h.r.c. fuses.

Liverpool, 10. E. JACKS,
Chief Engineer, Fusegear Division,
English Electric Co., Ltd.

Engineering in Europe

Abstracts from Foreign Journals

THE Central Research Laboratory of the Russian Ministry of Power Stations has designed and tested comprehensively an ignitron-type all-electronic exciter for a 3,000 kW turbo-alternator. In principle, an ignitron circuit comprising three ignitrons and one " buffer-valve " (the latter either replacing a faulty ignitron without loss of time, or used additionally for forced excitation) were found to represent a satisfactory excitation system, provided the problem of the ignition control of the ignitrons could be solved. Several variants of thyratron circuits were tried and one including an isolating transformer was eventually adopted as the only solution assuring an acceptable service life of the thyratrons (the latter went up from 2,000 to 11,000 hours or more). This type of exciter is particularly suitable for work with a generator-compounding system and not only ensures greater stability of the operation, but also a higher amplification factor than a rotary exciter.—" Testing and Operational Experience with Excitation of a 3,000 kW Turbo-Generator by an Ignitron Circuit," Yu. A. Shmain, *Elektrichestvo,* No. 12, pp. 32-34, 1956, in Russian.

Transformer Noise Suppression

Previous methods of transformer noise suppression were either not very effective or too costly. They were also bound to interfere to some extent with the operation of the transformers (e.g. reduction of the flux density, or the use of acoustic barriers or cushions in the tank). Three new methods discussed in the article are more promising and also possess economic advantages. The first is the arrangement of resonant sound absorbers on the tank walls for the most troublesome frequency of 100 c/s and its harmonics. These absorbers are simple rubber elements cemented to the tank walls at the points of antinodes of the vibrations concerned. The noise reduction which can be achieved is about 7 to 8 phon.

A different type of resonant oscillator, to be used on smaller transformers, takes the form of strips or discs of sheet material, fixed by studs to the tank wall, and preferably used in sets for all the frequencies to be eliminated. The interference method of noise reduction is based on a different principle. It applies only to the sound already produced and propagated by the air and requires a rather elaborate electronic set-up with a phase-shifter and a loudspeaker. The loudspeaker emits the actual transformer noise simultaneously with the original noise, in phase-opposition, so that theoretically the noise is cancelled out. In practice a considerable noise reduction is achieved, but mostly only in one definite direction (opening angle of " dead " zone about 10 to 20 deg). A similar effect can be obtained, and much more cheaply, by fixing tuned vibrating discs on the tank. This results in an average noise reduction of 10 phon.

The last method discussed is to surround the tank with flexible outer walls, which also introduce reductions of 8 to 9 phon. Under unfavourable conditions several methods may be combined and supplemented by some of the older methods of sound absorption.—" New Methods of Suppressing Noise in Large Transformers," E. Reiplinger, *VDE-Fachberichte,* Vol. 19, I/124-127, 1956, in German.

Arc Characteristics

Considering the fact that the first " artificial " electric arc was produced 155 years ago, and the immense amount of theoretical and experimental research devoted to electric discharges in general and arc discharges in particular, it is surprising that no reasonably satisfactory analytical expression of the VA-characteristic of an electric arc can be found. The problem is important obviously only for arcs of technological interest, viz. either " useful " or " dangerous " arcs, as these represent only a relatively small group out of the practically unlimited multitude of possible arcing phenomena. It is true that there are some empirical formulæ of rather limited application, and representing more or less correctly only part of the complete VA-characteristic, like Ayrton's or Telnyi's formula, but they also are inconvenient to use because they involve too many constants to be determined.

It is fortunate that nature sometimes " proceeds " in analogous ways in different phenomena, and the analogy in this case exists between the voltage-current relations in electrolysing an acid solution and in the electric arc. It is, of course, only a formal analogy, but it helps in getting nearer a workable formula. The procedure to be followed is to add terms considering known physical facts about the arc, in terms of arc length, resistance and current, and to find the inter-relations of these parameters step by step, using physically defined limits, such as the minimum arc current for the experimental set-up employed. In this way it is actually possible to arrive at a formula representing a very acceptable approximation to the actual VA-characteristic for both d.c. and a.c. arcs, considering the ambient temperature. An important and successful application was made to large arc furnaces.—" VA-Characteristics of D.C. and A.C. Arcs," P. V. Sergeev, *Elektrichestvo,* No. 12, pp. 25-28, 1956, in Russian.

Temperature Rise of Iron

The temperature rise of iron sheets of 3·5 mm thickness, as used in the construction of switchgear cubicles and sleeves for h.v. bushings as well as other constructional elements of substations, was investigated to determine the limiting currents permissible in conductors passing through or near ferromagnetic constructional elements. The currents used in the experiments were 600, 1,000, 1,250 and 1,500 A and the experimental results could be represented by an empirical formula relating the temperature rise, °C, with the current, kA, causing it. It takes the form $\Delta\Theta = 30I^{1.85}$. The current limit up to which steel sleeves may be used is 1,500 A; where steel is used only for fastening plates, the limit is 1,800 A, provided these are not parts of a closed magnetic circuit. In a closed magnetic circuit the corresponding limits are 1,000 A and 1,500 A, respectively. Lids of transformer tanks are not subject to these limitations.—" Temperature Rise of Iron Parts near Conductors Carrying Heavy Alternating Currents," Z. Radl, *Elektrotech. Obzor,* Vol. 46, No. 1, pp. 37-41, 1957, in Czech.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review.*

VIEWS on the NEWS

By REFLECTOR

LAST week I saw another advertisement by an American firm offering attractive terms to scientists and technologists to persuade them to join the organisation. Also the flow of emigrants to Canada includes numbers of men of this type—a type which is in great demand in this country. Small wonder, therefore, that one leading British electrical group has issued a counterblast to the siren call of North America. In this A.E.I. introduces the conception of the "psychological emigrant" who "leaves not so much with a new found faith in the new world as with a newly lost faith in his own country." The announcement goes on to show that this country is by no means finished. Indeed, by quoting examples of what is being done here, the group shows that something of a "scientific renaissance" is in progress and a new generation of scientists is needed to carry it on.

* * *

Pressing though our own needs are, there is, of course, another side to the shield. For generations British engineers and scientists have gone overseas to countries in which they have made their mark and exercised considerable influence in Great Britain's favour. A substantial part of our export trade has been built up in this way and it would be a disservice to the country to stop the flow entirely. It may legitimately be argued that their work has been done in comparatively undeveloped countries, whereas men going to North America will be absorbed into those countries' systems. I admit the difference but still think that it is no bad thing for some of our engineers and scientists to spend at least a few years in Canada or the United States. We can always hope that they will return to impart new ideas to British industry even if they are not big enough in numbers to impress British methods on transatlantic firms.

* * *

Readers of the *Evening Standard* who recall the discussions on the position of the B.I.F., in which some people suggested that Castle Bromwich, Birmingham, was not too easily accessible, may have been puzzled one day last week by a paragraph which said:—

> "Sir Cullum Welch, the Lord Mayor, is considering taking his coaches as well as the regalia of his office when he goes to Helsinki for the British Industries Fair in September. But the high cost of such an expedition may rule it out."

Actually, the Fair is still at Birmingham and in May; the reference was to a British Trade Fair which has been arranged in Finland.

* * *

When the extra 1s tax was imposed on petrol London Transport not only recovered it by raising bus fares but also imposed an increase in fares on the electrically-operated Underground Railways and trolley-buses. Now apparently it intends to maintain the higher charges and, indeed, to apply for permission to increase fares still more. Of course expenses continue to rise but provincial transport undertakings, with generally lower load factors, seem to be able to keep their fares within more reasonable limits. Worse than this, the electrified suburban railways, which surely must be making a profit, are also endeavouring to raise their fares, apparently to subsidise the bus services. In this field, of course, the Monopolies Commission has no powers of investigation.

* * *

The starting-up of new plant is normally regarded as an occasion for celebration. At Hove recently there was a different ceremony, marking the closing down of the last rotary convertor at "Seeboard's" Hove Street substation. It was, says the *Brighton and Hove Herald*, a passing that nobody minded attending and past and present members of the staff gave a final cheer as the machine, bedecked with a black wreath, whined to a stop. The wreath bore the ingenious inscription "Born 1926. DeCeACed 1957." Apart from the liberty taken with spelling, the rotary convertor actually began life a year earlier, as shown by the 32 candles on the iced cake which graced the table at the subsequent informal celebration tea.

* * *

Under the heading "Serious Problem Solved," the *Electrical World* (New York) reports that

> "Jacksonville (Fla.) police have kept lights burning in the basement of police headquarters for three years now. Sgt. Steve Torda, Jr, says this keeps roaches from coming in and licking the glue off envelope flaps—a delicacy they particularly savor."

* * *

Whenever I hear complaints about our backwardness in education and training methods I wonder how Great Britain ever attained the eminent industrial and technical position she still holds in the world. Sixty years ago things looked as bad as they are said to be to-day, judging by an editorial in the *Electrical Review* of 23rd April, 1897. Commenting on the situation of technical education this said:—

> "It is wonderful to think that England should have persistently neglected this branch of national development. While England has been resting upon her record, Germany and France have been going ahead. . . . In these countries facilities are offered by the Government, which enable those who wish to get on, to succeed. . . . We have in this country no State-supported laboratories, no encouragement is given to those who wish to succeed or who are desirous to contribute to the sum total of scientific knowledge which is possessed by the people at large. . . . We cannot command the markets as we used to do, and all because we, as a nation, do not recognise the importance of providing facilities for training the integral part of the nation."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. J. Rostron, M.I.Loco.E., has been appointed assistant sales manager, Traction Department, of the Metropolitan-Vickers Electrical Co., Ltd. Mr. Rostron was educated at Bury Grammar School and Manchester College of Technology. He served his

Mr. J. Rostron

Mr. J. Dummelow

apprenticeship with the L.M.S. Railway, joining the Electric Traction Department at Bury in 1931 and later transferring to Carlisle in connection with diesel-electric traction work; in 1940 he moved to Derby, becoming a technical assistant in the chief mechanical engineer's office. Mr. Rostron joined Metropolitan-Vickers in 1946 in the Traction Sales Department, where he has been connected with many important electric and diesel-electric contracts for home and overseas railways.

Mr. J. Dummelow, M.A., A.M.I.E.E., has been appointed assistant manager of the Publicity Department of Metropolitan-Vickers. He was educated at Marlborough and Clare College, Cambridge. After a college apprenticeship followed by technical publicity work with M.-V., he joined the publicity organisation of the General Electric Co., Ltd., in 1929. During the war he served with the Royal Engineers. He rejoined Metropolitan-Vickers in 1946 and became editor of the "M-V Gazette" and Press officer. Mr. Dummelow is a member of the British Association of Industrial Editors. He is also a Freeman of the City of London, being Renter Warden of the Wax Chandlers Company.

Mr. E. M. Gamble, who has recently joined the board of Camp Bird Industries, Ltd., has been appointed to the board of Photo Printed Circuits, Ltd., Brookwood, Surrey. Photo Printed Circuits is one of the companies within the Hartley Baird Group in which Camp Bird recently acquired a controlling interest.

The annual general meeting of the Sussex Centre of the **Electrical Industries Benevolent Association** will be held on Monday, 6th May, at 5.30 p.m. at the offices of the South Eastern Electricity Board, Castle Square, Brighton, 1, Sussex.

Mr. I. L. Collins, A.M.I.E.E., the district engineer, District 344 (Merthyr/Aberdare), has been appointed district engineer, District 348 (Cardiff West), in place of the late Mr. Stanley Gough. Mr. Collins entered the electricity supply industry in 1925 on the staff of the Cardiff Corporation Electricity Department, and in 1948 he joined the staff of the South Wales Electricity Board and remained at Cardiff until he was appointed district engineer, District 342 (Merthyr), in 1950. As a result of a district reorganisation in 1955 he became district engineer, District 344.

Mr. H. Wilcock, formerly southern sales manager at Hoover House, London, has been appointed general manager, Hoover S.A. (Proprietary), Ltd., Johannesburg, South Africa.

The South Western Electricity Board announces the appointment of **Mr. L. Locker,** A.M.I.E.E., to be sub-area engineer, Bristol, responsible for the Board's engineering work in Bristol, Bath, Weston - super - Mare and a wide area of North Somerset. Mr. Locker is at present the Board's district manager in East Cornwall, and he will take up his new duties on 24th April. He was educated at Rotherham Grammar School and Technical College and joined Rotherham Corporation Electricity Department in 1932. From 1939 to 1945 he served in the Royal Corps of Signals and as Capt. Locker was mentioned in despatches for his services in Malaya and Burma. In 1946 he joined the Bath electricity undertaking as testing and substation engineer, and in 1948 he was appointed senior technical engineer of the Cornwall Sub-Area of the South Western Electricity Board. In 1950 he was promoted deputy sub-area engineer, Cornwall, and two years later he became district manager, East Cornwall.

Mr. L. Locker

Mr. H. R. Broadbent, B.Eng.(Hons.), traction engineer in the development division of the Department of the Chief Mechanical Engineer (Railways), London Transport, has been promoted principal executive assistant. He will continue to be responsible for all investigations concerning traction problems, train characteristics and braking.

The annual meeting of the Batti-Wallahs' Society was held on 10th April when **Mr. L. G. Brazier,** B.Sc., Ph.D., M.I.E.E., director, and director of research and education, British Insulated Callender's Cables, Ltd., was elected president for 1957-58. **Mr. T. C. F. Bigland** and **Mr. J. Temple Hazell** were re-elected hon. secretary and assistant hon. secretary, respectively, and the following members were elected to the committee:—Messrs. J. S. A. Bunting, M. D. Cloran, H. A. Crabtree, K. Druce, G. H. L. Smith and H. H. Spencer.

Dr. L. G. Brazier

In addition to his directorship of B.I.C.C., Dr. Brazier is also managing director of British Dielectric Research, Ltd., and a director of British Telecommunications Research, Ltd. He is a member of the Council of the British Non-Ferrous Metals Association and of the Electrical Research Association, and is governor of Wrekin College.

Mr. T. A. Higgins, manager of the Expanded Metal Co.'s Electrical Department at West Hartlepool, left for New York on 15th April for a four weeks' business trip.

Mr. A. Wood has been appointed managing director of Henry Meadows, Ltd., in succession to **Mr. A. D. Mackay,** who has been appointed to the main board of the parent company, Associated British Engineering, Ltd. Mr. Mackay remains as deputy chairman of Henry Meadows, Ltd. As director of Associated British Engineering he will be responsible for the co-ordination and full development of companies in the A.B.E. group primarily concerned with its automotive, industrial and electrical activities. He commenced his association with the A.B.E. group as managing director of the Bergius

Mr. A. D. Mackay

Co., Ltd., in 1952. Since then his appointments have included deputy chairman and managing director of Henry Meadows, Ltd., director of British Polar Engines, Ltd., deputy chairman of the Bergius Co., director of the Free Piston Engine Co., Ltd., and director of Newtherm Oil Burners, Ltd.

The **Dumfries and Galloway Electrical Society** held its coming-of-age dinner in the Cairndale Hotel, Dumfries, on 2nd April, when the guest speakers were Mr. J. S. Pickles, chairman of the South of Scotland Electricity Board, and Mr. A. E. Rootes, manager of the Board's Ayrshire Sub-Area. Mr. Pickles, who was the first president of the Society in 1936, in proposing the toast of the Society remarked that of the fourteen presidents since its formation thirteen were present that evening. Mr. Rootes, who was president of the Society in 1938, proposed the toast of "The Electrical Contractors of Dumfries and Galloway." Mr. G. W. Briggs, station superintendent of the Galloway power scheme, who is the new president of the Society, presided at the dinner.

At the annual general meeting, which preceded the dinner, in addition to the appointment of Mr. Briggs as the new president, Mr. K. Fergusson was appointed vice-president, Mr. N. Rose, secretary, and Mr. W. Ferguson, treasurer.

In our last issue we reported the appointment of **Mr. G. S. Buckingham,** B.Sc.(Eng.) (London), M.I.E.E., as the chief engineer of the Midlands Electricity Board, in succession to Mr. G. F. Peirson, who is now deputy chairman of the Board. We have since received a copy of the portrait of Mr. Buckingham which we now reproduce.

Mr. G. S. Buckingham

The North West (Manchester) Area Golf Sub-Committee of the **E.I.B.A. National Golf Championship** is to hold its area qualifying competition on Stockport (Torkington) Golf Club's course on 1st May. All connected with the electrical industry are eligible to enter the medal competition over 18 holes for the Ferranti Trophy under handicap. The winner, together with the competitor returning the next best score and the competitor returning the lowest scratch score, are eligible to take part in the national final to be played at Manchester on 30th September. There will also be a veterans' competition for those over 55, a visitors' competition and a putting and greensomes competition. Entry forms can be obtained from the organising secretary, Mr. J. K. Dean, Metropolitan-Vickers Electrical Co., Ltd., Ship Canal House, King Street, Manchester, 2.

Mr. L. Champion has been appointed to the board of the Sheaf Electric Supply Co., Ltd. Mr. Champion joined the General Electric Co., Ltd., in 1936 at its Sheffield branch and joined the Sheaf Electric Supply Co., Ltd., as manager in September, 1954. Mr. Champion has had considerable experience in connection with switchgear, fans, electrical accessories and colliery signalling.

Mr. L. Champion

Mr. W. H. Darlington, M.B.E., Ph.D., chief engineer, Gas Turbine Engineering and Gear Engineering Departments of the Metropolitan-Vickers Electrical Co., Ltd., has been awarded the 1956 Silver Medal of the Institute of Marine Engineers for his paper, "Some Considerations of Wear in Marine Gearing." The medal is awarded annually for the best paper read during the year by a non-member of the Institute. Dr. Darlington received his technical education at the City and Guilds College, London, and served a post-graduate college apprenticeship course with Metropolitan-Vickers from 1935 to 1937. After serving as an engineer in the Mechanical Engineering Department, he became a section leader, and was concerned in the wartime development of the gas turbine, for which work he was awarded the M.B.E. Subsequently he became assistant chief engineer, and later chief engineer, of the Condenser Engineering and Gear Engineering Departments. In 1956 he was appointed chief engineer of the Gas Turbine Engineering and Gear Engineering Departments.

Dr. W. H. Darlington

Mr. J. Grant Glassco, O.B.E., F.C.A., has been appointed a director and executive vice-president of the Brazilian Traction Light & Power Co., Ltd.

The ninth annual dinner of the Southern Meter Engineers' Technical Group of the **Electrical Power Engineers' Association,** which was held on 12th April, was presided over by Mr. A. A. Yardley (Ferranti, Ltd.), chairman of the Group. There were only two toasts—"Our Guests" and "The Chairman." The first was proposed by Mr. R. Thompstone (vice-chairman), who expressed the thanks of members to those who had contributed to the success of the technical meetings of the Group by presenting papers —in particular to Mr. D. B. Irving (chairman, London Electricity Board) for delivery of the opening address of the present session. Mr. Thompstone concluded by referring to the need for more papers to be submitted to the Committee.

Responding, Mr. Irving gave some amusing reminiscences on his recent visit to Russia and Czechoslovakia. He also referred appreciatively to the work of the Group Committee and its hon. secretary, Mr. O. G. Davies.

In proposing the health of the chairman, Mr. L. B. S. Golds briefly sketched the professional career of Mr. Yardley, which had started with electricity supply before his transference to the meter sales side twenty-eight years ago. This was his second term of office as Group chairman in which his hard work, good humour and courtesy were notable assets.

In his response, the chairman referred to the formation of the Group in 1943 as the London Meter Engineers' Association, which was incorporated in the E.P.E.A. the following year. It was the only Group of its kind in the country. The number attending the present function, he said, was the highest yet—185 compared with the total membership of the Group of 212, but it included several guests. Thanks were due to the manufacturers for their support, to Mr. C. Phebe for acting once more as entertainer, and to Mr. O'Dea for the efficiency and humour which he again showed in his capacity as toastmaster.

Mr. J. O. Hitchcock, a director of the Mond Nickel Co., Ltd., has been elected a director of Henry Wiggin & Co., Ltd.

Mr. G. I. Watson, resident engineer, Great Yarmouth generating station, has been appointed deputy station superintendent, Norwich, as from 1st April. Mr. Watson commenced his service in the industry with the Yorkshire Electric Power Co. in 1927, being appointed a shift charge engineer at Great Yarmouth station in 1947, deputy station superintendent in 1949 and to his present position at Great Yarmouth in April, 1955.

Mr. G. I. Watson

Somerset Maugham's "The Noble Spaniard" was the play selected by the **Portland Players** (Central Electricity Authority Sports and Social Club) for presentation at the Portland

Hall, London, on Thursday and Friday last week. The play is set in the early Victorian era and concerns an English party on holiday in Bologne, one of whom is a young widow who attracts the amorous attentions of a Spanish duke. A string of mistaken identities creates many hilarious situations, and the whole company entered into the fun with enthusiasm. Antony Hemming was the dashing noble Spaniard, and Margaret Corkish as the young widow played the part with charm. They were well supported by Marjorie James (as Lady Proudfoot), James Rintoul (Mr. Justice Proudfoot), Gladys Feast (Lucy), Margaret Spooner (the maid), Anthony Moss (Captain Chalford), Ian Clarke (Count de Moret), and Dorothy Stannard (Countess de Moret).

Mr. J. H. Davis, A.M.I.E.E., whose article on "Silicone Insulated Motors" appears in this issue, received his technical education at the College of Technology, Birmingham, and the Royal Technical College, Glasgow. He served in the Royal Navy from 1945 to 1948, first as a rating and then as an officer in the electrical branch. Afterwards he was with the Automatic Telephone & Electric Co., Ltd., and Simplex Electric Co., Ltd., and joined the General Electric Co., Ltd., Witton, in 1951, as an insulation development engineer and later became a production engineer. Mr. Davis was awarded an I.E.E. Students' Premium during this period for his article "Silicone Insulation." He is now with Midland Silicones, Ltd., Technical Service Department, as head of the electrical engineering section, dealing with development in the field of silicone insulation, and providing technical assistance to the users of these materials.

Mr. J. H. Davis

OBITUARY

Mr. K. W. Tremellen.—The death is announced of Mr. K. W. Tremellen, who retired from Marconi's Wireless Telegraph Co., Ltd., at the end of 1952; he was sixty-eight.

In his early career Mr. Tremellen became closely associated with Marconi in many of his early experiments in wireless telephony both in this country and with the Italian Navy between 1912 and 1914. During this period he also began his lifelong vocation of specialist in the study of radio wave propagation and the then new science of radio direction finding. In 1915, as a captain in the R.E. Signals Branch, Mr. Tremellen was in charge of the establishment and operation of a chain of direction finding stations in France. In this capacity he noted and reported on the phenomenon of the erratic variation of wireless bearings known as "night-effect" which was simultaneously and independently observed in Egypt by Mr. T. L. Eckersley. After the war, in association with Captain H. J. Round and Mr. T. L. Eckersley, he engaged in the study of long wave propagation. With the advent of short wave communications in 1923 he turned his attention to the study of their propagation. His close association with the work of Eckersley in this field resulted in the establishment of the means of predicting short wave performances over any route throughout the year at any time of day or night, and when in 1941 the need arose for an Inter-Service Ionospheric Bureau, he was made scientific officer-in-charge of the work. For his services he was awarded the American Medal of Freedom.

Mr. R. T. Goymer, Associate I.E.E., died in hospital on 10th April after a short illness. He had been with the J. L. Eve Construction Co., Ltd., since its inception in 1930, dealing with transmission line and radio mast contracts.

Mr. G. A. Vowles.—The death occurred on 7th April, at the age of sixty-six, of Mr. George Alexander Vowles, O.B.E., M.I.E.E., M. I. Mech. E., who until his retirement in February last was controller of the Yorkshire Division of the Central Electricity Authority, a position he had held since vesting date. Before nationalisation he was chief engineer and transport manager of the Ipswich Electricity and Transport Department, and had previously been borough electrical engineer at Halifax. A full account of his career was published in our issue of 22nd February last at the time of his retirement. A memorial service was held on Tuesday last at St. Martin's Church, Potternewton, Leeds, which was attended by many well-known men in the industry.

The late Mr. G. A. Vowles

Mr. E. K. Richardson, district manager of the Thurrock District of the Eastern Electricity Board, died on 27th March at the age of fifty-eight.

A native of Farnworth, Lancs., Mr. Richardson received his education at Manchester Central High School, Manchester College of Technology and Salford Royal College of Technology, and during the early part of his career was with the Lancashire Power Co. and the Farnworth electricity undertaking. In 1928 he became manager of the Tilbury undertaking, which position he held until 1948, when he was appointed to the post which he held until the time of his death.

Mr. A. E. Foxlee.—The death has occurred of Mr. A. E. Foxlee, for over thirty years the representative of the Pritchett & Gold & E.P.S. Co., Ltd., in South and South West England and South Wales.

WILLS

Mr. E. Pinkston, sales director of Laurence, Scott and Electromotors, Ltd., who died on 22nd December last, left £33,821 gross (£32,890 net).

Mr. F. D. Newcombe, founder and director of F. D. Newcombe & Co., Ltd., electrical and radio wholesalers, who died on 2nd November last, left £42,528 gross (£35,017 net).

Mr. F. N. Rendell Baker, M.I.E.E., formerly chief engineer and general manager of the Croydon Corporation electricity undertaking, who died on 15th December last, left £16,249 gross (£15,994 net).

Mr. James Robinson, D.Sc., Ph.D., M.I.E.E., of Bromley, Kent, a former vice-president of the British Institute of Radio Engineers, who died on 21st October last, left £1,453 gross (£1,111 net).

Mr. W. S. Naylor, of St. Annes-on-the-Sea, Lancs, former chairman of the Chloride Electrical Storage Co., Ltd., who died on 29th November last, left £105,434 gross (£102,999 net). Among other bequests he left £100 to the Benevolent Fund of the Institution of Electrical Engineers.

Mr. G. N. Roberts, works manager of British Insulated Callender's Cables, Ltd., Helsby, who died on 19th December last, left £17,712 gross (£13,175 net).

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £242 0s 0d
Fire Refined 99·70%	ton £241 0s 0d
Fire Refined 99·50%	ton £240 0s 0d
COPPER Tubes ..	lb 2s 4½d
Sheet	ton —
H.C. wire and strip ..	ton £291 5s 0d
LEAD, English	ton £111 15s 0d
Foreign	ton £110 0s 0d
MERCURY	flask £86 0s 0d
TIN, block (English) ..	ton £771 10s 0d
ZINC, G.O.B. Foreign	ton £98 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 11½d
Sheet	ton —
Wire	lb 2s 8½d
PHOSPHOR BRONZE Wire	lb 4s 0½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27d—27½d

Manufacturing Progress in 1956

In the review of the activities of the Metropolitan-Vickers Electrical Co., Ltd., in 1956 which appeared on page 513 of our issue of 22nd March last an error occurred in the caption to the illustration of the waterwheel generators being erected at Bersimis, Canada. The four machines concerned are each rated at 138 MW, 13·8 kV.

INDUSTRIAL NEWS

Electricity Supply Foremen's Salaries

Following the increase of 2½d per hour to electricians, the salaries of foremen in the electricity supply industry have been increased by £30 per annum and the allowances for permanent shift work increased by £5 per annum as from 1st March. The rates are now: Grade 1 £715, Grade 2 £665, Grade 3 £615, and Grade 4 £565, plus £75 per annum permanent shift work allowance.

Former Electricity Supply Employees' Pension

The Minister of Fuel and Power has approved a 10 per cent increase in basic pension, with a maximum of £100, to be paid retrospectively from 1st April, 1956, to employees who retired from the electricity supply industry on or before 31st March, 1952. The removal of income limits and restriction to single pensioners, imposed by the Pensions (Increase) Acts, 1944-47 and 1952, and the subsequent interim arrangements were also approved by the Minister. Those with salaries of £1,500 a year or more immediately before retirement do not qualify for the 10 per cent increase unless they retired on or before 31st December, 1947.

F.H.P. Motor Manufacture

Members of local civic and education authorities and their ladies paid a visit to the British Thomson-Houston Co.'s Newcastle (Staffs.) works on 9th April. The visitors, accompanied by directors and senior executives of the company, made a tour of the works where they saw the modern methods employed in the production of fractional horse-power motors.

The Newcastle (Staffs.) works was acquired by the company from the Government in 1945 in order to meet the increasing demand for small motors. It was then re-equipped and personnel were trained for motor production. Since 1945, a new canteen and office block has been erected, and design engineering, drawing office and sales staffs have been transferred from Rugby.

This factory will be about twice as big as the Rugby works when the extensions now being built are completed. Motors ranging from one-eighth to one horse-power are made, and as many as 9,000 different ratings, types and sizes are produced.

The importance of training of craftsmen has been given high priority. Boys are trained as technicians, draughtsmen, and in appropriate crafts through five-year indentured apprenticeships. The training received is complementary to part-time study at the North Staffordshire Technical College at Stoke-on-Trent.

Redundancy at E.M.I. Works

A demand for Government intervention on the proposed discharge of more than 2,600 workers at the Electric & Musical Industries' plant at Hayes, Middlesex, before the end of the year was made last week at a meeting of shop stewards. A spokesman for the shop stewards and workers' representatives said that they had been informed by the management that, arising out of the merger of radio and television interests with Thorn Electrical Industries, Ltd., these workers would be surplus to requirements, as production of these commodities would be discontinued by the E.M.I. Hayes factories. The management was unable to make alternative proposals with regard to the employment of those proposed as surplus, a decision which the shop stewards' committee declares is completely unacceptable.

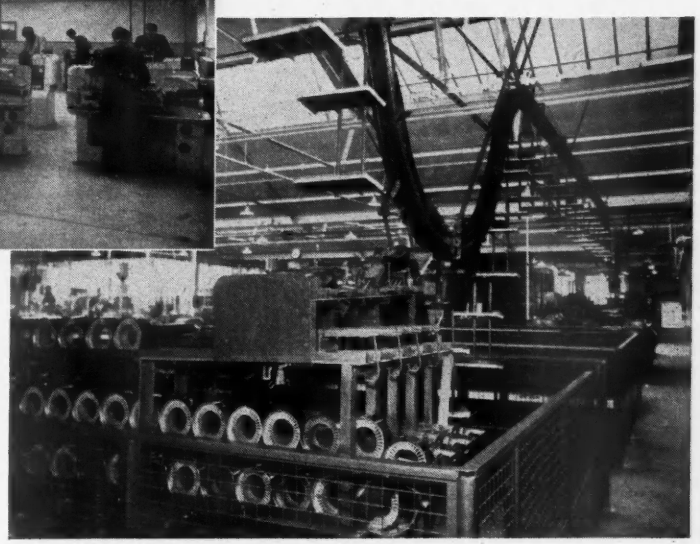
Large Nuclear Research Accelerator

The governing board of the National Institute for Research in Nuclear Science has decided that, subject to any necessary planning consent, the first accelerator which it is hoped to build for the Institute should be erected on a site that the Atomic Energy Authority will make available adjacent to its Research Establishment at Harwell. The choice of this site has been influenced by the immediate availability of land suitable for this heavy machine and the adequate arrangements which already exist for essential services. The A.E.A. hopes to make certain facilities at the Harwell Research Establishment available for the use of the Institute.

The precise specifications for this

SCOTTISH NUCLEAR POWER STATION

Next week's issue will contain a description of the South of Scotland Electricity Board's projected nuclear power station in Ayrshire. A four-colour graphic illustration of the station, specially prepared by the technical staff of the *Electrical Review*, will be included



Left: Apprentice Training Centre at the B.T.H. Newcastle (Staffs) F.H.P. Electric Motor Works. Below: Stators being automatically sorted according to size as they are delivered by overhead conveyor to the storage rack

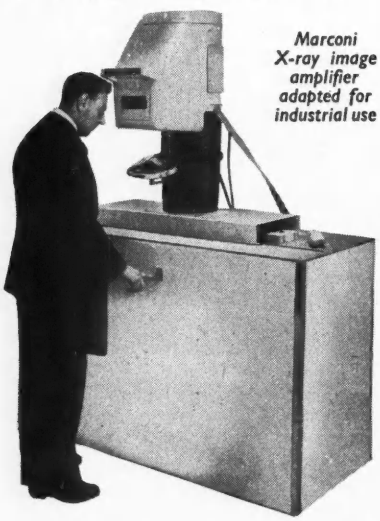
machine have not yet been determined and until this is done no final decision to proceed with the design and construction of the machine will be taken.

The decision to build the accelerator at Harwell does not imply that all the Institute's facilities would be situated there. Present indications are that the balance of advantage would be against concentrating the facilities in the Harwell area.

Marconi X-ray Image Amplifier

Intensive tests with the Marconi image amplifier have shown that it can be as valuable a tool of industry as it has proved to be in the field of medicine. The image amplifier is a fluoroscopic device containing an electronic optical system. It provides a "picture" much more brilliant than can be obtained by using the normal fluorescent screen. The optical system has been designed so that the final image can be viewed with both eyes in a plane mirror which may be tilted and rotated to suit operators of any stature.

As in the medical field, greater detail can be seen with less radiation and the saving of time and expenditure. For example, the production of a certain type of investment casting entails the rejection of some 50 per cent after radiographs have been taken. If all the castings are first examined under an image amplifier, over 30 per cent can be rejected without the need for radiography, the remaining 70 per cent being radiographed in the normal way. The saving in the cost of film is thus 30 per cent, in addition to the saving in time. The system overcomes the usual objections to fluoroscopy as a subjective method of testing since no component is passed into service which has not first been radiographed.



Marconi X-ray image amplifier adapted for industrial use

Man Killed by Disused Line

A verdict of misadventure was recorded at an inquest at Andover (Hants) last week on Goliath Ayres. A police witness said that Ayres was thought to have climbed a pole at the end of a half-mile stretch of overhead line which had been used to supply a former R.A.F. camp. An official of the Southern Electricity Board said that the pole carried a two-phase line operating at 11 kV. Although the R.A.F. had moved out about twelve months ago, the Board had kept the cable "live" to keep it in a healthy condition and so prevent deterioration. It was proposed shortly to use the line to feed a farmhouse and neighbouring cottages. The coroner, Col. J. T. P. Clarke, said that it was beyond his comprehension why this line was left alive. He could not see any reason for it except neglect on someone's part.

Course for Schoolchildren

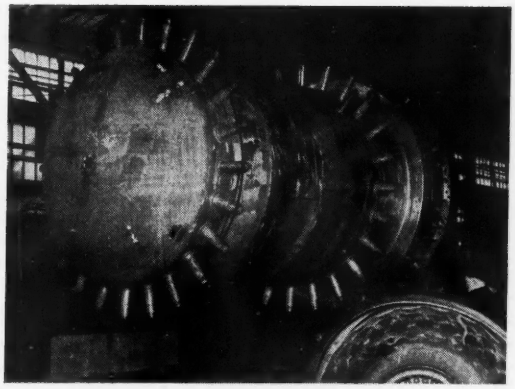
During last week the Metropolitan-Vickers Electrical Co., Ltd., held an Easter vacation course for schoolboys and schoolgirls from public and grammar schools throughout the country. During the week more than forty fifth and sixth formers were guests of the company, and gained first-hand engineering experience through a programme of progressive practical training in the Apprentice Training School. Half of each day has been spent in the training school under instruction, and the other half devoted to visiting manufacturing departments and laboratories.

Registration of Restrictive Trading Agreements

The Registrar of Restrictive Trading Agreements announces that the public register is open daily from 10 a.m. to 4.30 p.m. (except on Saturdays). The register may be inspected on payment of a fee of 1s a day in London on the 7th floor at Chancery House, Chancery Lane, W.C.2; in Edinburgh at 9, Wemyss Place, Edinburgh, 3; and in Belfast at Chichester House, 64, Chichester Street. There will be a public search room at each of these addresses, together with indexes of the commodities which are the subject of agreements on the register.

Fast Breeder Reactor Vessel

A 30-ton stainless steel container for Britain's first full-scale fast breeder reactor left John Thompson's works at Wolverhampton on 5th April for Dounreay, on the north coast of Scotland, where it will be installed along with liquid-metal heat exchange systems and boiler plant manufactured by John Thompson for the United Kingdom Atomic Energy Authority. This container has taken eighteen months to build and its overall dimensions are 20ft by 14ft. On site at Dounreay, the reactor vessel will be placed in position in a concrete "vault," which acts as a biological shield for the reactor and all the primary liquid-metal circuits taking heat from the reactor. For many months John Thompson construction men have been at work within the "vault," assembling and welding the circuits which will be connected to the reactor vessel when it is placed in position.



John Thompson reactor vessel being loaded for transport to Dounreay

A Century and a Quarter

The business of William McGeoch & Co., Ltd., began in Glasgow before the commencement of the electrical era, in 1832. Then the firm went in for ironmongery and at later stages added ships' brassfoundry and oil and candle lamps and eventually an electrical supplies department was established. Electrical manufacture was started at the present Birmingham works in 1882 and the works has constantly been modernised to keep abreast of developments.

The company claims to have been one of the first to make electric lampholders and it was a pioneer in the introduction of electrical fittings into ships. Control has remained in the hands of the McGeoch family since the foundation of the business. The present chairman, Mr. Lauchlan A. McGeoch, is a grandson of the founder. His brother, Mr. William McGeoch, served the company for 63 years until his death in 1949, and two great-grandsons of the founder, Messrs. W. Percy McGeoch and Andrew J. McGeoch, are with the company. A brochure has been issued illustrating and describing the company's works and activities.

Glass Insulator Exports

Nearly a million toughened glass high voltage insulators were exported by Pilkington Brothers, Ltd., in 1956. The total of 901,444 insulators sent to twenty-five countries showed an increase of 242,091 on the previous year. The value of the exports was £700,193 (against £496,638 for 1955).

One of the year's biggest orders was for approximately 300,000 insulators for the Kariba hydro-electric scheme in Rhodesia. This is not included in the 1956 figures as the insulators have not yet been delivered.

Diesel Generating Sets for Canada

J. & H. McLaren, Ltd., Leeds, have secured a $124,000 order from the Radio Corporation of America for the supply of power plant for micro-wave telecommunications equipment in Canada. This will be followed by orders for more than a quarter of a million dollars for additional equipment for an extended scheme. The order is for diesel-electric equipment required to provide a continuous source of supply to radio apparatus for a wireless telegraphy scheme in the Province of Manitoba. McLarens will supply their Petter-McLaren type PD air-cooled diesel engine generator sets and another Brush Group company, Petters, Ltd., Staines, will supply two Petter AVA2 air-cooled diesel engines. Initially five mains standby plants—three of 10 kW and two of 5 kW—will be installed, together with three duplicate stations each consisting of two diesel generator sets rated at 10 kW.

Hoover "Life Test" Laboratory

The "life test" laboratory in the engineering department of the Perivale, Middlesex, factory of Hoover, Ltd., has recently been redesigned and enlarged to cope with the growth in the range of the company's products. In this laboratory products and components are tested for safety and durability to an extent far beyond the stresses and strains likely to be experienced in their normal use. In other laboratories on the same floor investigations are made into the electrical, chemical and structural properties of materials and components.

The new laboratory is divided into two large, air-conditioned and sound-proofed rooms. The following are some of the tests carried out:—Mechanical operator, simulating working conditions for electric polishers and steam-or-dry irons; switch testing by switching on and off up to 50,000 times under normal electrical load; wire tests, including abrasion resistance or scrape test and thermoplastic flow test designed to determine what degree of heat and pressure the enamel insulation on the wire will withstand before breaking down; testing of flex by constantly winding it on and off clips and twisting and distorting it while heavily weighted; static test on irons, by constant operation at the highest point of their temperature range; running washing machines for 500 hours with the equivalent of a full load of clothing and running the wringers continuously while an endless belt of varying thickness is fed through the rollers; and continuous running tests with cleaners and polishers up to 1,000 hours.

The show windows at the new headquarters of the Copper Development Association at 55, South Audley Street, W.1

New C.D.A. Display Room

A new display room was opened on 9th April by the Copper Development Association at its new headquarters at 55, South Audley Street, London, W.1. Viscount Chandos, who formally opened the showroom, said that new uses and new applications for copper, provided that they were true and not forced applications, added to everybody's wealth. He wished the Association every success in its task of expanding the uses of copper.

Designed by the Association's architectural consultant, Mr. A. L. McMullen, M.A., F.R.I.B.A., the display room has eight display recesses—electrical; engineering; metallurgy; roofing; pipework; domestic; agricultural; and chemical, each section exhibiting some particular application of copper or copper alloys.

The Association has issued a list of C.D.A. 16 mm films which are available, free of charge, to organisations.

Electronic Computer Exhibition and Symposium

An electronic computer exhibition, to include data handling equipment of all kinds, is to be held at Olympia, London, from 28th November to 4th December next year. The exhibition will be the first of its kind to be held in Great Britain. It is being sponsored, at the suggestion of the National Research Development Corporation, by a joint committee of the Radio Communication and Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association under the chairmanship of Mr. J. A. Cumming, chairman of the Exhibition Committee of the latter Association. Concurrently

Executive and sales staff who attended the recent sales conference of Bill Switchgear, Ltd., at the company's Birmingham works

with the exhibition there will be a symposium at which papers dealing with the applications of computers to problems in business, industry and science will be read and discussed. Inquiries should be addressed to Mr. J. F. Richardson, technical secretary, Radio Communication and Electronic Engineering Association, 11, Green Street, London, W.1.

Change of Name

Tungstalite, Ltd., a member of the Parnall group of companies, has changed its name to Ascot Lamps & Lighting, Ltd. Mr. Z. Deshaw, formerly managing director of Ismay Lamps, Ltd., has been elected to the board and appointed managing director with effect from 1st April. The requirements of all the previous customers of Tungstalite, Ltd., will in future be met by Tungstalite (Sales), Ltd., 47, Farringdon Road, E.C.1, of which company Mr. B. Wexler is managing director.

Preventing Icing on Aircraft

"Spraymat" electrical heater elements manufactured by D. Napier & Son, Ltd., have been applied to the leading edges of the fin and tailplane of the Bristol "Britannia" airliner, and its elevator horn balances, as a safeguard against ice formation. They consist of flame-sprayed metal elements of either aluminium or kumanal which is sandwiched between layers of insulating material, the base insulation acting as an adhesive to secure the heater to the component.

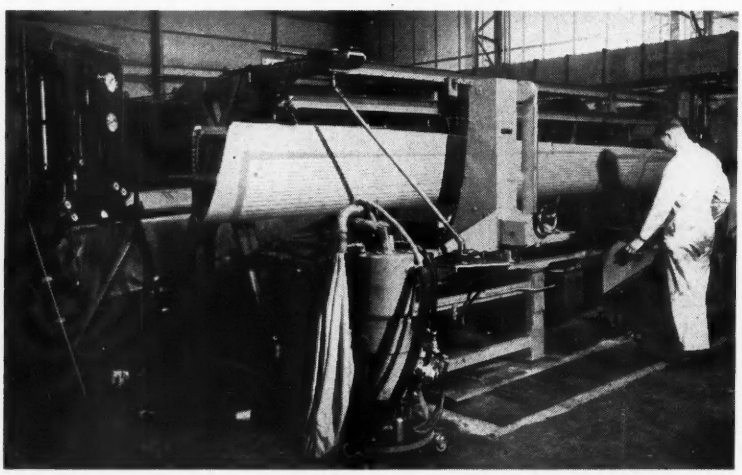
There are two main types in use, both of which employ sprayed copper busbars to carry the current from one element to the next at each change of direction. Type 1 embodies a flame-sprayed insulation compound which is oven-cured at a temperature of 180 deg C, and in icing conditions the elevator horn balances are continuously warmed by this type of heater operating from the 112 V d.c. system. Each 3 kW heater serves an area of 3·56 sq ft. The insulation of Type 2 heaters, which are used for the leading edges of the fin and tailplane, is applied as a liquid with layers of glass cloth acting as a bonding agent, the curing temperatures being between 80 and 100 deg C. Each tailplane heater has an effective area of 53·8 sq ft and contains fifteen independent heater circuits; the fin heater contains eleven circuits and covers an area of 32·6 sq ft. All circuits operate from the 208 V a.c. three-phase supply.

Serious mechanical damage is repaired by a grafting process in which the damaged area is removed and a new section of heater sprayed on to restore the "Spraymat" to its original condition. For minor repairs a special repair kit is used to bridge broken elements by element-coated insulated strips.

Large Walking Dragline

To remove the overburden at the Crosby Warren ironstone quarry in Scunthorpe, the Ore Mining Branch of the United Steel Companies, Ltd., is now using the first walking dragline of its size to be manufactured in this country. Known as the W600, the dragline has a maximum capacity of 10 cu yd at 184ft dumping radius, with a boom length of 186ft. It is at present operating on an overburden of some 50ft thickness of clay and sand, which is expected to increase in depth as the quarry advances. Weighing 795 tons, the W600 can remove about 400 cu yd of spoil per hour, thus enabling an average production of 15,000 tons of ironstone per week to be obtained. Designed and erected on site by Ransomes & Rapier, Ltd., the dragline is electrically operated throughout and controlled by a Ward-Leonard amplidyne system. Power is supplied at 6,600 V through trailing cables, the main motor generator set being of 1,500 h.p. This set serves two 225 h.p. drag motors, two 225 h.p. hoist motors, two 225 h.p. walk motors and two 125 h.p. rotate motors. The motor generator set and all the motors were supplied by the British Thomson-Houston Co., Ltd. All the motions of the machine are controlled from a cabin projecting from the front of the main superstructure. The two walking shoes are each 35ft long and 7ft wide, and the machine advances in 6ft strides.

Special rig for mechanically spraying the elements of the "Britannia" tail unit heaters. A tailplane leading edge heater element is shown complete and stripped of tape before being unloaded from the rig



Australian Lamp Duty Inquiry

The *Board of Trade Journal* announces that the Australian Minister for Trade has referred to the Tariff Board for inquiry and report the question whether assistance shall be given to the production of filament lamps. At present automobile lamps are admitted free of duty; on other filament lamps for lighting or heating the British preferential rate is 1s per lb, the intermediate rate 2s 6d per lb and the general rate 4s per lb. Notification by United Kingdom interests of their desire to tender evidence must be given to the Australian authorities by 25th April. Before that date trade associations or firms intending to submit evidence should notify the Commercial Relations and Export Department, Board of Trade, Horse Guards Avenue, S.W.1 (Ref. No. C.R.E. 4194/57).

Illumination Design Course

This year's Illumination Design Course, arranged by the Lighting Service Bureau in London, will be held from 15th to 17th May. Applications to attend should be made to the Bureau at 2, Savoy Hill, London, W.C.2.

Automatic Heating Controls

With the title "Don't Heat the Crows," the Rheostatic Co., Ltd., Slough, Bucks., has issued a leaflet, written in non-technical language, which explains to the layman the necessity for proper automatic controls on heating systems.

Trade Announcements

The new Birmingham stock depot of **Davis & Timmins, Ltd.,** is at Wharfdale Road, Tyseley, Birmingham, 11 (telephone: Acocks Green 4281).

E. K. Cole, Ltd., have appointed Mr. J. N. Thompson as radio and television sales representative for the Birmingham and Warwickshire area.

The **M.C.B. Co. (Manchester), Ltd.,** Altrincham, Ches., announces that its main stockists in the London area are the National Electrical Supplies Co., Ltd., National House, 240/244, King Street, Hammersmith, London, W.6 (telephone: Riverside 4655).

Ottermill Switchgear, Ltd., has appointed the Scanlan Electric Co. Proprietary, Ltd., Coward Street, Mascot, N.S.W., Australia, as its agents in Australia.

FUEL AND POWER INVESTMENT

Programme for 1957 with Prospective Expenditure up to 1965

LAST week the Government published a White Paper on "Capital Investment in the Coal, Gas and Electricity Industries" (Cmd. 132, Stationery Office, 8d). This summarises the programmes for 1956 and 1957 of the national Boards concerned after the annual reviews by the Ministers concerned and reports to the Ministers by the Boards. Table 1 shows the expenditure incurred and proposed by the Boards.

TABLE 1.—BOARDS' CAPITAL PROGRAMMES (£ MILLION)

Board	Approved Expenditure 1956	Estimated Expenditure 1956	Approved Expenditure 1957
National Coal Board	107	96	107
Central Electricity Authority and Area Boards	195	209	233
South of Scotland Electricity Board	18	17	20
North of Scotland Hydro-Electric Board	18	19	21
Gas Council and Area Boards ...	52	52	59
Total	390	393	440

It is noted that these figures are for the industries' financial years and exclude working capital. They also vary from the figures given in "Preliminary Estimates of National Income and Expenditure 1951-56" (Cmd. 123) as they include expenditure on land and the purchase of existing buildings and do not allow for deductions on account of receipts from the sale of existing assets.

A revised estimate of the C.E.A. and the South of Scotland Electricity Board puts the cold-weather demand in 1959-60 in the areas which they serve at 23,800 MW and, allowing for actual expenditure so far, the total cost of development in England and Wales over the period 1953-54 to 1959-60 is estimated to be £1,520 million.

With the nuclear power programme the main increase in expenditure resulting from the substitution of nuclear for conventional stations will not come until the 1960s, but in the period up to 1965 the additional cost is put at £750 million above the estimated figure of £2,600 million which the provision of conventional stations alone would have cost.

Approval had been given to the expenditure of £195 million in 1956-57 but subsequent developments, including quicker delivery of plant and an earlier start for work on the nuclear power programme, led to the figure being raised to £209 million.

For 1957-58 the approved expenditure is £233 million; details are set out in Tables 2 and 3.

TABLE 2.—C.E.A. AND AREA BOARD ESTIMATED PROGRAMMES

	1956–57 £ million	1957–58 £ million
Generation—		
Conventional stations	108	108
Nuclear stations	3	12
Main transmission	23	25
Distribution	75	88
Total	209	233

TABLE 3.—ESTIMATED DISTRIBUTION EXPENDITURE (INCLUDED IN TABLE 2)

Details	1956–57 £ million	1957–58 £ million
Rural development	7·5	7·5
Other new connections	30·8	33·5
Reinforcement of existing systems	32·4	40·6
Workshops, depots, stores, garages, offices, etc.	1·3	2·2
Other expenditure (including standardisation)	3·4	4·2
Total	75·4	88·0

With the contracts now in hand the C.E.A.'s cash borrowings and contractual commitments now exceed the present limit. Actual borrowings to date amount to about £1,010 million. A substantial part of the outstanding commitments will be financed from internal resources and the Minister of Power will make further proposals to Parliament in due course for increasing the industry's borrowing limit.

When the South of Scotland Electricity Board was first set up it was estimated that it had to meet a cold weather load of 1,450 MW in 1955-56 which is expected to rise to 1,850 MW by 1959-60. The total expenditure of the Board for the period 1957-60 is likely to be about £85 million.

Table 4 shows the Board's approved expenditure for 1957 as compared with the expenditure in 1956. Most of the expenditure on generation will be incurred at the coal-fired station at Kincardine which will also account for much of the transmission expenditure. A small amount may be incurred on nuclear generation, and rural electrification will cost some £800,000.

The capital expenditure of the North of Scotland Hydro-Electric Board for the period 1957-60 is likely to be about £83 million. Table 4 also shows the allocation of capital for 1957, against the expenditure in 1956. The proposed expenditure is predominantly for hydro-electric work and is needed to provide additional generating capacity,

TABLE 4.—APPROVED EXPENDITURE OF SCOTTISH BOARDS FOR 1957 AGAINST EXPENDITURE IN 1956 (£ MILLION)

Purpose	South of Scotland E.B.		North of Scotland H.E.B.	
	1956	1957	1956	1957
Generation	8·46	9·77	14·91	15·80
Transmission	1·13	2·28	1·58	1·92
Distribution	6·82	7·25	2·93	3·00
Other	0·52	0·77	0·05	0·08
Total	16·93	20·07	19·47	20·80

TABLE 5.—PROSPECTIVE CAPITAL BUDGETS OF THE C.E.A. AND THE SOUTH OF SCOTLAND BOARD FROM 1956-57 TO 1965-66

	Assuming that nuclear generating plant with an output capacity of 6,000 MV will be in commission by the end of December, 1965		Assuming that all generating plant commissioned or under construction during the period was conventional
	£ million		
I. Generation and transmission			
1. Expenditure on stations commissioning before 1961			
(a) Conventional stations	460		
(b) Transmission ...	170	630	630
2. Expenditure on stations commissioning between 1961 and 1965			
(a) Conventional stations	316		
(b) Nuclear stations			
(i) Construction ...	742		810
(ii) Initial fuel charges	177		
(c) Transmission ...	225	1,460	
3. Expenditure on stations commissioning after 1965			
(a) Conventional stations	60		
(b) Nuclear stations			
(i) Construction ...	145		115
(ii) Initial fuel charges	15	220	
(c) Transmission ...	—		
II. Distribution		1,000	1,000
III. Increase in working capital requirements		40	45
Total		3,350	2,600

together with transmission and distribution facilities, to meet the rapidly growing load in the North of Scotland and to give increasing supplies to the South of Scotland Board.

An appendix to the White Paper gives particulars of the revised nuclear power programme and the division of the expenditure of the C.E.A. and the South of Scotland Board for this purpose is shown in Table 5. From this it will be seen that up to 1965 nuclear power development will add some £750 million to the two authorities' capital expenditure. Of this £650 million represents the cost of stations which will actually be in commission by 1965 and about £190 million for the initial fuel charges is also included.

In the 1955 White Paper it was estimated that 1,500-2,000 MW of nuclear capacity would cost the authorities perhaps £230-£240 million while expenditure by the Atomic Energy Authority on ancillary plant was expected to cost a further £60-£70 million—a total of £300 million. The table shows that the comparable cost of building nuclear stations for an output of 6,000 MW and charging them with fuel is now estimated at £919 million. Expenditure on prototype development is largely independent of the size of the current power programme, and with the technical developments of the last two years and the great economies obtainable with increasing throughput in the ancillary plants, no more capital investment is likely to be needed to provide these plants for a 6,000 MW programme than was thought necessary two years ago for a programme of 1,500-2,000 MW.

DEBATE ON THE BUDGET PROPOSALS

IN his Budget speech on 9th April, the main details of which were reported last week, the Chancellor of the Exchequer, Mr. Peter Thorneycroft, said he was confident that there would be an increase in exports. World trade was growing and British manufacturers were making a strong effort to expand their markets abroad. It was essential to an expanding economy that we should sell more abroad. Increased production in any other terms would merely increase our import bill. Since 1952 there had been a rapid increase in investment. It was 12 per cent of the gross national product in 1947 and 16 per cent in 1956, but we must seek opportunities to do more.

In the coming year, and beyond, he saw no sign of stagnation in investment. In the public sector the plans for investment in atomic energy, for coal and for transport were large. The problem posed by the plans for the basic industries and the publicly-owned part of the economy was not, in the main, whether we could contemplate too little, but how we could manage to do so much. Yet we were right to do it. We needed more power, more steel, and more transport facilities. Investments such as this were vital to the economy.

The Chancellor's proposal to reduce the purchase tax on some household goods from 30 per cent to 15 per cent expressly excluded appliances and apparatus operated by electricity or gas. The Chancellor did not give his reasons for making this exclusion. The subject was taken up in the debate, however. Mrs. Lena Jeger, in a sarcastic speech, asked why the "man-ridden" Government insisted upon continuing the penal tax on electrical household appliances. She asked: "Why not take this tax off altogether? If the Chancellor will not do that, why is he so pernickety as to keep it at 30 per cent on anything designed for operation by electricity or gas? Anybody would think we are living in the Stone Age when we are supposed to use a bit of flint to get a spark to start the fire. Surely we live in an age when woman has every right to expect in her home the use of electricity and gas?"

She said the Chancellor had put the housewives in an equally stupid position over electric irons. Again, why should a refrigerator be regarded as a luxury which had to be taxed? A refrigerator in every home was one of the test standards of a real rise in the standard of living.

After attacking the high rate of purchase tax on electric immersion and convector heaters, on vacuum cleaners and washing machines, Mrs. Jeger called the Budget an anti-housewives' charter because the concessions were so small.

Mr. Rankin said that the Chancellor was grossly unfair in putting the £1 tax on television sets. Television was appealing more and more to an older type of audience and would not detract from cinema audiences.

Mr. Harold Wilson, referring to the £34 million to be given in concessions to surtax payers, said that many scientists, technicians, designers and junior executives were a long way below the £2,000-a-year mark and they would get nothing, except when they had older children at school. In fact, the Budget would have the effect of lengthening the emigration queues, not shortening them. Nothing had been done to help either exports or investments.

Sir David Eccles, President of the Board of Trade, said that export orders had been much better in the last few weeks than had been forecast. The demand for capital goods greatly exceeded the investment to meet it. In physical terms domestic investment in plant and machinery could not now be significantly increased without cutting into exports. Overseas demands for semi-durable and consumer goods had recently improved.

The Australian Government had substantially reduced the import restrictions and prospects were also better in South Africa. Sales in Europe expanded last year by 12 per cent and in Germany alone by 20 per cent. It was clear that we were now competitive, by and large, with European prices.

Mr. R. Moss asked whether any effort had been made to sell electrical appliances in Scandinavia. When he was in Sweden he was asked why we did not make a bigger effort to do so.

Sir David Eccles agreed that complaints had come from Sweden that we were not making the sales drive there that we might make with advantage. Turning to other markets, he said that discussions with the United States Government and other allies for ironing out the China differentials would, he hoped, start very soon. There were, however, plenty of goods not on the embargo lists which we should like to sell to China and countries behind the "Iron Curtain." The Government had had some interesting discussions with the Polish mission which recently came to Britain and he thought more trade would follow. Mexico, Venezuela and Brazil, to mention only three of the Latin American republics, were full of promise for the exporter. Apart from the loss of the Egyptian market, trade in the Middle East had held up well.

British Association Meeting

THIS year's meeting of the British Association for the Advancement of Science is to be held in Dublin from 4th to 11th September. The president is Professor P. M. S. Blackett, F.R.S., Professor of Physics at Imperial College, London, whose address will be entitled "Technology and World Advancement." The president of Section G.—Engineering is Sir David Anderson, principal of the Royal Technical College, Glasgow; his address will deal with education and training for the engineering industry.

Among the subjects to be discussed in Section G are the following:—Energy and power supply; rainfall, run-off, water supply and power; computing in the modern world; advances in telecommunications; and engineering problems associated with heat transfer.

One of the evening discourses which are a feature of these meetings will be given by Dr. H. J. Bhaba, F.R.S., secretary of the Indian Department of Atomic Research.

INDUSTRY AND THE HOUSE

The Electricity Bill Leaves for the Lords

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

SOON after its seven weeks in committee the Electricity Bill was reported back to the full House in a two-day debate—the second day included the Third Reading. The same faithful group of Members from both sides who had devoted themselves to the fortunes of the measure from the beginning saw it through to the bitter end. Spread thinly over the green benches we were only occasionally joined by newcomers. Notable among these was Mr. Herbert Morrison, now retired from the Opposition front bench to two rows up " below the gangway." His arrival caused interest because it was thought that having returned from a longish absence in the United States he was a little critical of the Opposition's decision not to oppose the Bill in principle. However, when he did reveal his thoughts it was evident that his differences from the rest of us were rather those of emphasis than anything stronger. This does not surprise me. After all, it was Herbert Morrison who first suggested the idea of a seven-year check on the efficiency of a nationalised undertaking. Also, in days gone by he has been strong in the view that once public opinion has accepted national ownership then all points of view should play a constructive part in improving methods of administration—a subject always close to his heart.

In his speech Mr. Morrison made a valid point of the danger that the Electricity Council, being primarily advisory and not executive, would not have enough to do and might get into some mischief because of its idleness. Presumably here he was referring to functionaries of the Council, because the members being, in the main, chief executives of Boards, will surely have more than enough to do. The Opposition had, of course, already in the Committee " upstairs " taken the point in a sense, because we had advocated wider general powers for the Council and that it should be strengthened in membership to carry the extra powers.

National Fuel Policy

The only other relief to the routine examination of the Bill on Report (many points left open in Committee were finally cleared up by Government amendments in response to undertakings given) was two divisions on the Wednesday. The first of these was on an official Opposition amendment providing that in exercising his powers under Section 7 of the Act the Minister should pay regard to " developing the electricity supply industry in relation to a national policy for the efficient utilisation of all primary and secondary forms of energy." The debate caused several clashes between Members and the Deputy Speaker who after a time ruled to the effect that while it would be in order to show the need for such a clause, it would be out of order to discuss the policy which might be followed were the clause adopted. Unlucky Mr. Warbey, the Labour Member for Ashfield, was in the end ordered to resume his seat because his arguments were not, in the form in which he put them, acceptable to the chair.

In reply Mr. Maudling, the Paymaster General, contended that the clause was unnecessary because already, by the basic Act which had established the previous Ministry of Fuel and Power, the Minister had the duty of securing co-ordinated development of fuel and power resources. The proposed new clause was defeated with a Government majority of forty-one.

The majority fell later to the low figure of thirty-two on another amendment—much more contentious—brought in by the Minister himself in response to his own back benchers' pressure, to restrict the right of the new Generating Board to manufacture plant. It would be tedious to re-state the issues in detail. On the one hand, defenders of the right to manufacture, who had included Government spokesmen earlier, contended this was a traditional right of supply undertakings; that it was a purely reserve power unlikely to be used lightly; that a public corporation, like an individual or a company, should not be forced to buy; and that public Boards must be encouraged as far as possible to take a normal commercial view of their own activities.

The objectors to the right to manufacture, on the other hand, have said that nationalisation of electricity should mean a public service for the supply of energy and nothing beyond that; that it might be a " back door " way of nationalising electrical plant manufacture; and, in any case, a right to manufacture reflected a socialistic rather than a good Conservative outlook on policy.

Controlled Prices

I cannot conceal easily my own view that the first set of arguments is infinitely stronger than the second and it is a pity that the issue has been raised at all in view of the controversy likely to come along fairly soon on the bigger issue of the controlled price practices alleged against the electrical manufacturers by the Monopolies Commission. Parliament should look at this second question in the most open-minded way and that so much heat should have been generated in advance over a minor issue not mattering a lot one way or the other is a pity. The new formula allows the Electricity Boards to make anything for research and maintenance, but not to go beyond this definition.

Vice-Admiral Hughes-Hallett, a retired naval officer who sits for Croydon North East as a Conservative, has taken throughout a refreshingly individual point of view on the Bill. Over the right to manufacture he quarrelled with Mr. Nabarro, naturally now in a buoyant mood; the Admiral argued that the Minister's " concession " would incite public ownership later on to try its hand in the manufacturing field.

The Third Reading debate, apart from the interest of Mr. Morrison's intervention, was a quiet send-off to the Bill on its journey to the Lords. By then the Conservative " fuel furies " had lost their zest for the business and the majority of the short speeches came from the Labour side of the House. These mostly commended the Bill in a qualified fashion and pointed out that final success depended, as ever, upon the workers, engineers and managers of the undertakings outside. The only two notes of strong controversy were provided by Mr. Renton's attempt to explain again the Government's rural electri-

fication policy, on which apparently, like the Opposition, many of his own supporters still have doubts, and Sir Frank Soskice's contention that if the electricity supply industry was to fulfil its public obligations then it must have the public credit behind it.

As one who has listened to practically every word uttered in the Commons on this legislation and has been guilty of uttering quite a lot of words himself, I can only remark now that on balance I think constructive work has been done by Hon. Members in all parts of the House. One or two engineering friends in the industry have written to me to the effect that their respect for Parliament has been increased by reading the reports of the debates. That is praise indeed !

PARLIAMENTARY REPORT

Mr. Harold Macmillan, the Prime Minister, informed Mr. H. Hynd that the United Kingdom was not party to the Euratom Treaty which was signed on 25th March, but they had been engaged for some time in a programme of practical co-operation in atomic energy matters with the countries forming Euratom and with other Western European countries. The Government had said that they would consider participating in a joint experimental reactor project which did not form a major part of their own development programme, and would provide advice for the construction of a pilot processing plant for spent reactor fuels in which certain Continental countries were particularly interested.

They had reached an agreement in O.E.E.C. on a standstill in regard to trade restrictions and were pressing ahead with a scheme for the removal of all restrictions on trade, tariffs, etc., in atomic machinery. They were operating a special agreement which the Atomic Energy Authority had with France and the Netherlands, and had also an agreement with the Governments of Belgium and Germany. If it would be of interest and value, he would certainly consider the publication of a White Paper giving all the details of this practical co-operation which they were trying to achieve.

In reply to Sir John Crowder, Mr. Macmillan said that an Order in Council had been made transferring to him the functions formerly exercised by the Lord President of the Council (Lord Salisbury) in relation to atomic energy. The Paymaster General would assist him in the discharge of these functions.

Proposed New London Tube

Mr. Ernest Davies asked the Minister of Transport what consultations he had had with the British Transport Commission in regard to the construction and financing of the new Victoria line tube, and what action he proposed to take.

Mr. Harold Watkinson said his discussions with the Commission had not yet reached a stage at which he could usefully make any statement.

Channel Tunnel

Mr. Cronin asked the Minister of Transport if he would make a statement on the Government's policy on the construction of a Channel Tunnel.

Mr. Watkinson said that consideration was now being given as to whether recent developments called for any change in policy.

Mr. Gresham Cooke said that if there was a change in policy there should be a road section as well as a rail section.

Mr. Watkinson: " So far no plans have been found feasible for a road tunnel and a rail tunnel alone would probably cost about £100 million."

Women Science Teachers

Mr. Eric Fletcher asked the Parliamentary Secretary to the Ministry of Education what steps were being taken to recruit a larger number of women teachers in science and mathematics.

Sir Edward Boyle said more than 40 per cent of women science graduates already entered the teaching profession. The number of girls taking science subjects at the advanced level of the General Certificate of Education had increased rapidly in the last few years, and this, coupled with the expansion of the universities, should yield more science teachers. More courses in science subjects for non-graduates were being provided in the teacher training colleges, and his department's programme of supplementary courses was being expanded.

ENGINEERING WAGES INQUIRY

Two days were devoted last week by the Court of Inquiry into the wages dispute in the engineering industry to hearing evidence from both parties. For the trade unions, Mr. W. J. Carron, president of the Amalgamated Engineering Union, said that the unions believed that there had been no serious consideration of their claim for a 10 per cent increase in wages until the Minister of Labour intervened. They had now been offered 3½ per cent on conditions, but even without conditions the offer was too low. It was contended that the present rates did not provide reasonable standards of life for the men concerned and there had been a continued increase in the cost of living. The industry was prosperous and the workers had a right to share in that prosperity. Tens of thousands did not get much more than the minimum rates; those who got high wages earned them by extra hours, extra effort or because of their special skill.

The unions, Mr. Carron said, did not believe that a 10 per cent increase would price British goods out of overseas markets.

On behalf of the employers, Mr. B. Macarty, director of the Engineering and Allied Employers' National Federation, refuted the argument that the current rates of wages did not provide a reasonable standard of living; the standard had continued to improve ever since the end of the war. The unions constantly ignored the fact that most of what they termed " profits " had to be retained in the business for financing stock and work in progress, the maintenance of equipment, the purchase of new equipment, and for providing funds for research and development and education and training.

Recent reports from large engineering companies had shown that the threatened serious trading difficulties were now making themselves felt. Much of the trouble was caused by the failure of production to keep pace with rising wage rates. The Federation had now received wage claims on behalf of women workers, draughtsmen, clerical staffs and other employees of the industry.

Mr. Macarty stressed the importance of improving this country's competitive position in world markets by greater efficiency and productivity. He claimed that the granting of a 10 per cent increase in wages would cost £110 million, but this figure was contested by Mr. Carron.

Another matter raised by Mr. Macarty was the disruption caused by restrictive practices and breaches of agreements by the trade unions. Mr. Carron said that to suggest that this was a large problem was " a lot of nonsense."

Both Mr. Macarty and Mr. Carron expressed their preference for wage negotiations within the industry rather than arbitration.

At the conclusion of the evidence Professor D. T. Jack, chairman, said that the Court would do its best to produce its report in the shortest possible time.

Insulation of Electric Tongs

Protection under Electricity Regulations

By LAURENCE WEBLEY

A RECENT case before the Inner House of the Court of Session, Edinburgh (*Mutch* v. *Scotts Shipbuilding & Engineering Co., Ltd.*), is of interest to users and manufacturers of electric welding tongs because the Court refused to agree to a construction of the Electricity Regulations requiring these tongs to be insulated.

The Electricity (Factories Act) Special Regulations, 1908, require all apparatus to be so constructed and protected as to prevent danger so far as is reasonably practicable. However, Exemption 4 in the Regulations provides that:—" Nothing in these Regulations shall apply to any process or apparatus used exclusively for electro-chemical or electro-thermal . . . purposes." This exemption is subject to a proviso that the process must be so worked and the apparatus must be so constructed and protected as to prevent danger.

The plaintiff, an electric welder in a shipyard, burnt his hand on the uninsulated tube of a live tong. The tong, one of a number of similar types used in shipbuilding, consisted principally of a metal holder grasping an electrode. The part which held the electrode was bare. The plaintiff claimed that the live part of the tong should have been insulated and, as it was not, it did not satisfy the proviso to Exemption 4. Consequently, the employers could not rely on the exemption.

The employers retorted that if there was a breach of the Regulations whenever the head of a tong was not completely insulated then every shipyard in Scotland had been in breach of them since 1908. Only complete insulation of the head of the tong would have prevented the accident and such insulation would make electric welding impossible.

The Court observed that the accident was due to an extraordinary conjunction of circumstances. The injured man was working with gloves and a shield with eyepieces. He found it necessary to change these eyepieces and laid down his tong, leaving it live, and also his shield by the side of it. He then took off his gloves and was just reaching for the shield to alter the eyepieces when the lights went out and he touched the tong in the darkness. No evidence had been found to indicate that it was the normal practice of firms using these electric welding tongs to cover them completely, except at the tip of the electrode, with an asbestos or Bakelite insulator.

The Court considered that, in fact, the tong could not be completely insulated. Regulation 1, when it required that a conductor which, of course, was what this tong was, should be protected as far as reasonably practicable, did not require that the protection should be by means of insulation. Under the Regulations " conductors " could be bare, indeed many of the Regulations referred to such conductors. By " protection " the Regulations meant something in the nature of a physical barrier. However, this type of conductor could not be protected, or placed and safeguarded so as to prevent danger. It was for this reason that Exemption 4 provided for the non-application of the Regulations to electro-thermal processes.

Accordingly, the Court held that the proviso to Exemption 4 did not mean that the " conductor " in such circumstances should be covered with insulating material. The Court added that perhaps the protection envisaged by the proviso meant gloves, dry floors, and the like. Having regard to the language of the exemption a construction had to be placed upon this proviso which would not prevent electro-thermal processes from being undertaken. The appeal was dismissed.

The proviso to this exemption certainly presents some difficulty as, after the exemption is given, the proviso appears to require measures which are impracticable. This, however, should not cause difficulty to users and manufacturers in view of the Court's declaration that the proviso must not be construed so as to interfere with the welding process.

Staffing Public Services

THE problem of attracting staff into the public services under full employment is not more onerous than in other fields of employment. This was the view expressed by Mr. A. C. Jensen, assistant director of establishments, Central Electricity Authority, in a group discussion arranged by the Royal Institute of Public Administration on 8th April.

Speaking with the electricity supply industry in mind, Mr. Jensen gave some account of the factors influencing the flow of staff into the employment of the Central Authority and the Area Boards. At any rate for young entrants, the " glamour " exercised by nuclear power was a dominating consideration: the idea of being at the centre of such an enterprise was catching the imagination of young school leavers.

As to the manual workers, the industry had tried to reduce the difference between them and the clerical staff. Superannuation, holidays and sickness pay had been provided on a similar though less extensive basis. Mr. Jensen thought that the salary scales of clerical staff were too short: those who reached the top had no further incentive, though the effect of this was lessened by the practice of advertising all jobs internally and thus keeping open a steady stream of promotion. They must not only attract staff but keep them. The problem of turnover was severe. By means of courses of induction training the industry sought to get staff " into the run " quickly and so to give them a sense of belonging. Their publicity was of two main kinds: prestige advertisements, booklets etc., designed to indicate the scope and appeal of the industry as a whole, and others intended to attract the interest of particular readers like schoolmasters or careers advisers; they even appealed to the younger schoolboy so as to get him used to the idea that the electricity industry was a new and exciting thing.

Miss B. N. Seear (London School of Economics) thought that the public services must reconcile themselves to the fact that they would not be able to recruit staff in the quantity or the quality they desired. They must therefore do their best with what they could get and that involved training them. In planning training courses it was essential to relate them to the actual jobs to be done. If students were led to expect a kind of work they did not get there would be a high labour turnover.

ELECTRICAL ENGINEERS' EXHIBITION

Survey of the Earls Court Display

EQUIPMENT worth more than £2 million was displayed at the sixth annual Electrical Engineers' Exhibition organised by the Association of Supervising Electrical Engineers which was held at Earls Court, London, last week. Some 40,000 items of equipment were on view, ranging from generating plant weighing 8 tons to transformers the size of a wedding ring. This was the largest exhibition ever staged by the electrical manufacturers in this country and nearly 400 firms took part, their stands occupying an area of 330,000 sq ft.

The high standard of stand design set by last year's display was well maintained and there was great variety in appearance, which with liberal and tasteful use of colour and lighting created a very pleasing overall effect. However, the actual layout of the exhibition could have been improved in some respects. The main entrance led on to a confusing number of small stands and there seems to be no reason why a more striking arrangement could not have been adopted here. Another irritant to visitors, who can rarely afford to waste time by getting lost amongst the maze of stands, was the rather poor signposting throughout the exhibition. The aisles were by no means clearly marked and those exhibitors who did go to the trouble of displaying their stand numbers made them so small that they could only with difficulty be identified, and could certainly not be seen from a distance.

Switchgear, electrical accessories and lighting fittings appeared to predominate in the exhibition and there was very little equipment on view which was completely new. The accent of the show was definitely on selling and many equipments were improved versions of well-established designs to meet the needs of customers in all parts of the world. Standardisation, ease of installation, and flexibility of operation are factors which have obviously been borne in mind when designing much of the apparatus displayed at Earls Court. This no doubt accounts for the fact that the electrical industry is the biggest exporting industry in the United Kingdom.

Careers Section

We all know that one of the greatest problems facing British industry is that of attracting "new blood." To assist in this direction a 7,000 sq ft "Come and be Trained" display was arranged on the first floor of Earls Court. The Central Electricity Authority indicated the careers available, particular emphasis being put on nuclear power, and the Institution of Electrical Engineers also took part in the display. In view of the large British programme of nuclear power station construction it was appropriate that models should be displayed of the stations to be built in Ayrshire, Essex and Gloucestershire. The Armed Forces, the B.B.C., four technical colleges and many industrial concerns were also represented. Although this particular feature of the exhibition cost many thousands of pounds it aroused such widespread interest, particularly among the parties of visiting schoolboys, that it should prove a very worth-while expense.

So far as switchgear and transformers are concerned there was very little that could be described as new. This is, of course, understandable in view of the fact that manufacturers comply with the specifications laid down for these main items of power plant. Switchgear and transformers formed a large proportion of the products on view, both h.v. and l.v. gear being shown in about the same proportion. There were a few interesting features to be observed in various kinds of gear. For example, the Yorkshire Switchgear & Engineering Co. displayed a complete outdoor ring main unit with spring assisted closing in both main and earth switches which have been tested to B.S. 2631/1955. It is the company's IVI range 6·6/11 kV unit. The circuit-breaker is also spring assisted and is manufactured for ratings of 150/250 MVA, the closing speed being entirely independent of the operator's effort. The two fault making/load breaking oil switches are of 400 A rating and up to 250 MVA at 6·6 kV. They may be fitted, if required, with an earth fault flow indicator operating on the core balance principle to facilitate rapid fault location. It is also worth mentioning that this gear incorporates a 30 V battery and charger, also overcurrent and earth fault relays in a separate free standing cabinet to the rear of the switches.

Cable Jointing Demonstration

An interesting demonstration was given by British Insulated Callender's Cables, Ltd., which illustrated the progress being made in the methods of compression jointing of aluminium cable conductors by hydraulic means. Specimens on show included l.v. tee joints, but we understand that a good deal of work has yet to be carried out before this method can be applied to very-high-voltage cables.

The Type OPT 75 MVA, 11 kV circuit-breaker by Reyrolles is a fairly new addition to rural distribution equipment. It is an outdoor pole-mounting three-phase unit suitable for direct connection to overhead lines. The mechanism is weight-operated and will give three auto-reclosures with each setting of the weight. It can be set to reclose the oil circuit-breaker in from 10 to 60 sec after the tripping, but if the circuit-breaker trips within 10 sec of reclosing it will be locked in the open position.

Apart from the development already mentioned in cable jointing, the cable industry had a further new item of interest to show, and that was the latest development in polythene-insulated h.v. power cables by the Telegraph Construction & Maintenance Co., Ltd. They included an experimental installation of 100 kV d.c. single-core, submarine cable.

A survey of the wide selection of low-voltage switchgear did not reveal any really new developments, the most interesting perhaps being the standardisation by the Simplex Electric Co., Ltd., of the components which make up their flameproof gear. This feature is a great improvement as it gives a user the advantage of utilising the gear to suit his own particular requirements.

A 150 MVA 6·6/11 kV vertical isolator type circuit-breaker, by Johnson & Phillips, has been designed to comply with British Electricity Specification S.2 whereby the manual operating mechanism is now brought into line. The operating handle is reversed for tripping, and the closing mechanism is designed so that closing can only be obtained in one swift action. The recent engineering strike had, we understand, caused a certain amount of inconvenience to some manufacturers in the preparatory

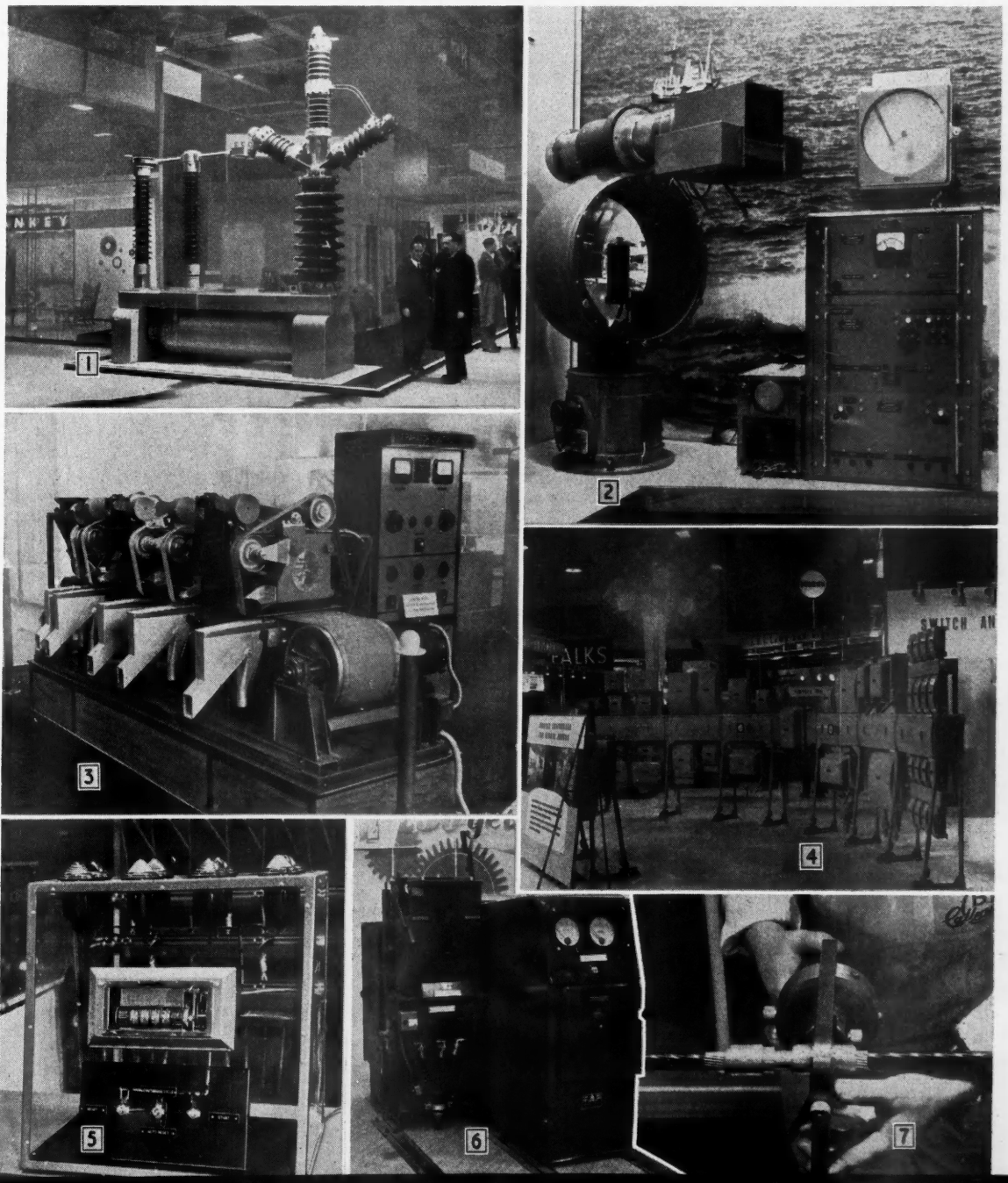
work necessary before the opening of the exhibition and in one or two cases firms were not able to produce their very latest developments.

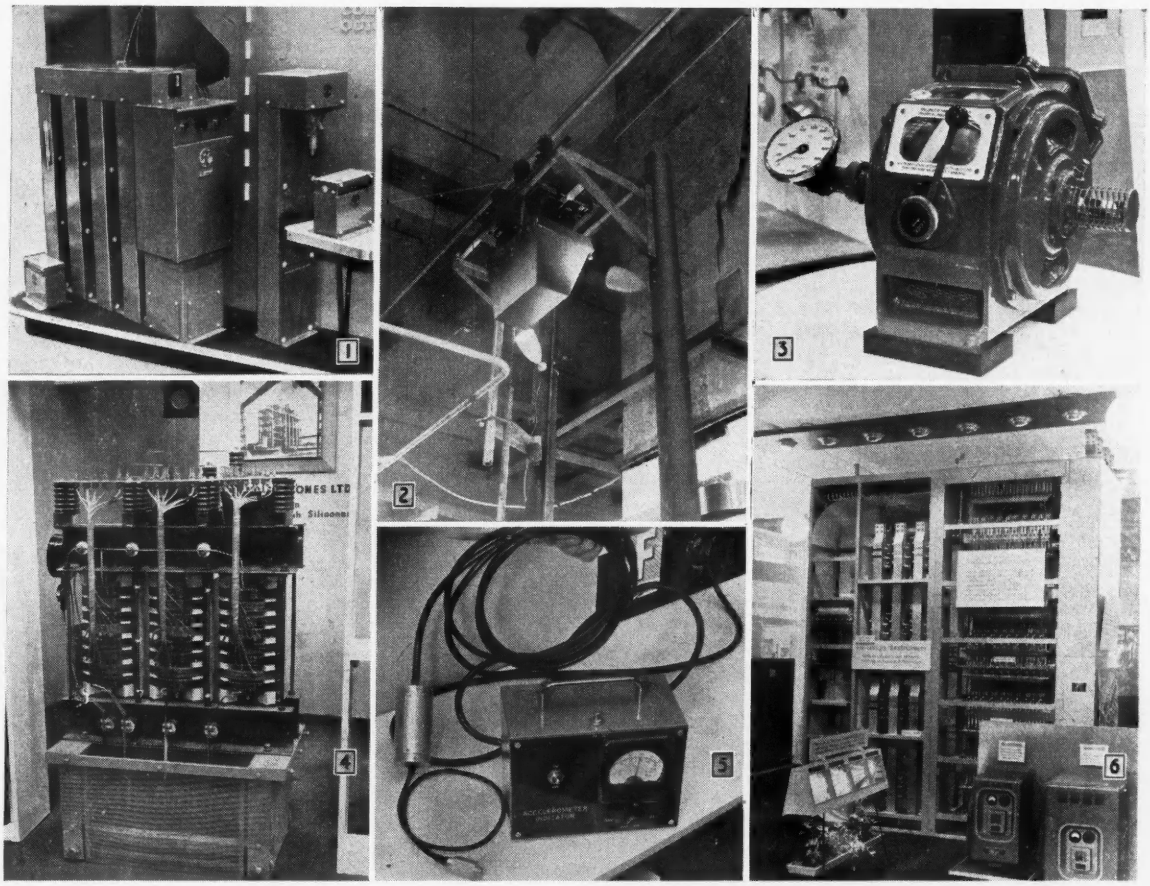
One switchgear manufacturer, namely, J. R. Ferguson (Electrical Engineers), Ltd., displayed an 11 kV ring main unit in which the busbars and spouts are totally enclosed in an epoxide moulding. This method of construction is believed to be the forerunner of basic changes in design for normal e.h.v. distribution switchgear.

Examples of cast resin insulated voltage transformers and "Butyl" insulated current transformers for service up to 11 kV were displayed on the Ferguson Pailin stand along with their latest 33 kV 1,000 MVA Type VSLP9 gear. This has integral earthing features for the feeders and busbars which has resulted in a reduction of the overall size of the gear and also gives a more compact and streamlined effect. A reduction in the sizes of some transformers and machines was also evident due to the application of the new Class "H" insulation which was more noticeable at this year's exhibition.

A fluorescent fitting which is fully protected against the ingress of moisture and corrosive agents can now be obtained from the Simplex Electric Co., Ltd. The fitting is completely sheathed in white p.v.c., all apertures are sealed and heat-resisting rubber is used for lampholder shrouds. Jointing of aluminium conductors, using "Junal 5" soldering flux, was demonstrated on the stand of Johnson & Phillips, Ltd. The results obtained by using this flux have proved that joints are more solidly filled than those made with the best organic flux. A

1. Ferguson Pailin 132 kV air-blast circuit-breaker. 2. Stone-Chance automatic fog detector unit. 3. Browning high intensity magnetic separator. 4. Simplex multi-way l.v. distribution board. 5. Multi-circuit process timer by El Rem Co. 6. Yorkshire Switchgear 6·6/11 kV ring main unit. 7. B.I.C.C. hydraulic compression jointing of aluminium cable





1. S.T.C. unit type p.f. correction capacitors. 2. Reyrolle pole mounting 11 kV oil circuit-breaker. 3. Brushless variable-speed induction motor shown by Metropolitan-Vickers. 4. Dry-type silicone insulated transformer by Brentford Transformers, Ltd. 5. Ferranti acceleration indicator. 6. Part of 450,000 A Westinghouse rectifier installation

further advantage gained in the use of the flux is that it makes for much healthier working conditions for the jointer since there are hardly any harmful and incidentally evil smelling fumes given off.

Lighting fittings were well represented and many of them were of contemporary design. For example, there were on show a number of plastic fittings with brightly coloured reflectors and, surprisingly enough, some had black reflectors.

Testing Equipment

As in the past, many types of testing apparatus were exhibited and one very interesting item on show was the phase-earth loop impedance tester. Instead of working on the current injection principle recommended in Regulation 507, this tester momentarily puts an actual fault from line to earth and is operated by the fault current. A Fuller on-load tap-changer was made into a most interesting exhibit; it was shown as a complete working assembly with electrical driving mechanism and control desk.

Among the new industrial equipment on view at the exhibition was an automatic fog detector unit, designed by the Chief Research Officer of Trinity House and developed by Stone-Chance, Ltd., through the National Research Development Corporation. This equipment received the 1957 award for the best industrial exhibit at the show. In similar vein Lancashire Dynamo Electronic Products, Ltd., introduced a smoke densitometer and alarm equipment designed to meet both B.S. 2740:1956 and B.S. 2811:1957. Both the light projector and photo-electric receiver are arranged for easy maintenance and cleaning, and are intended for mounting at a point of negative air pressure, air intakes being provided to furnish an adequate flow of clean air across the internal optical components exposed to the stack or flue. A full range of accessories is available to suit a wide variety of installation requirements.

For much industrial equipment designed for use under arduous conditions, it is necessary to resort to shock testing after manufacture. In using drop-type shock testing apparatus it often happens that, due to the generation of local shock waves, the test sample is subjected to values of " g " which differ widely from those calculated purely on a basis of mass, height of drop and retardation. Equipment shown by Ferranti, Ltd., enables the actual peak acceleration in " g " units to be indicated on a direct reading scale. The use of storage circuits permits the indicating instrument reading provided by a shock test to remain constant within 1 per cent for 15 sec and 2 per cent for 30 sec following the impact.

One of the largest items of industrial equipment shown at Earls Court was part of a 450,000 A 18-24 V rectifier installation supplying current to three continuous electrolytic tinning lines at the Velindre works of the Steel Company of Wales. This 9 MW installation incorporates oil-less and water-cooled selenium rectifier units, the cooling water subsequently being used for process

washing. The rectifiers are of unit construction, each unit being individually fused, readily withdrawable and electrically insulated from the cooling water. Air-cooled Class " H " silicone-insulated transformers, supplied by Watford Transformers, Ltd., are built into each 15,000 A unit. At Velindre, thirty of these units are being installed to provide 450,000 A and a fully automatic system is being provided to control the tinning process. Another interesting industrial item was a new high intensity magnetic separator, which was demonstrated by Browning's Electric Co., Ltd., dealing with feebly magnetic ores.

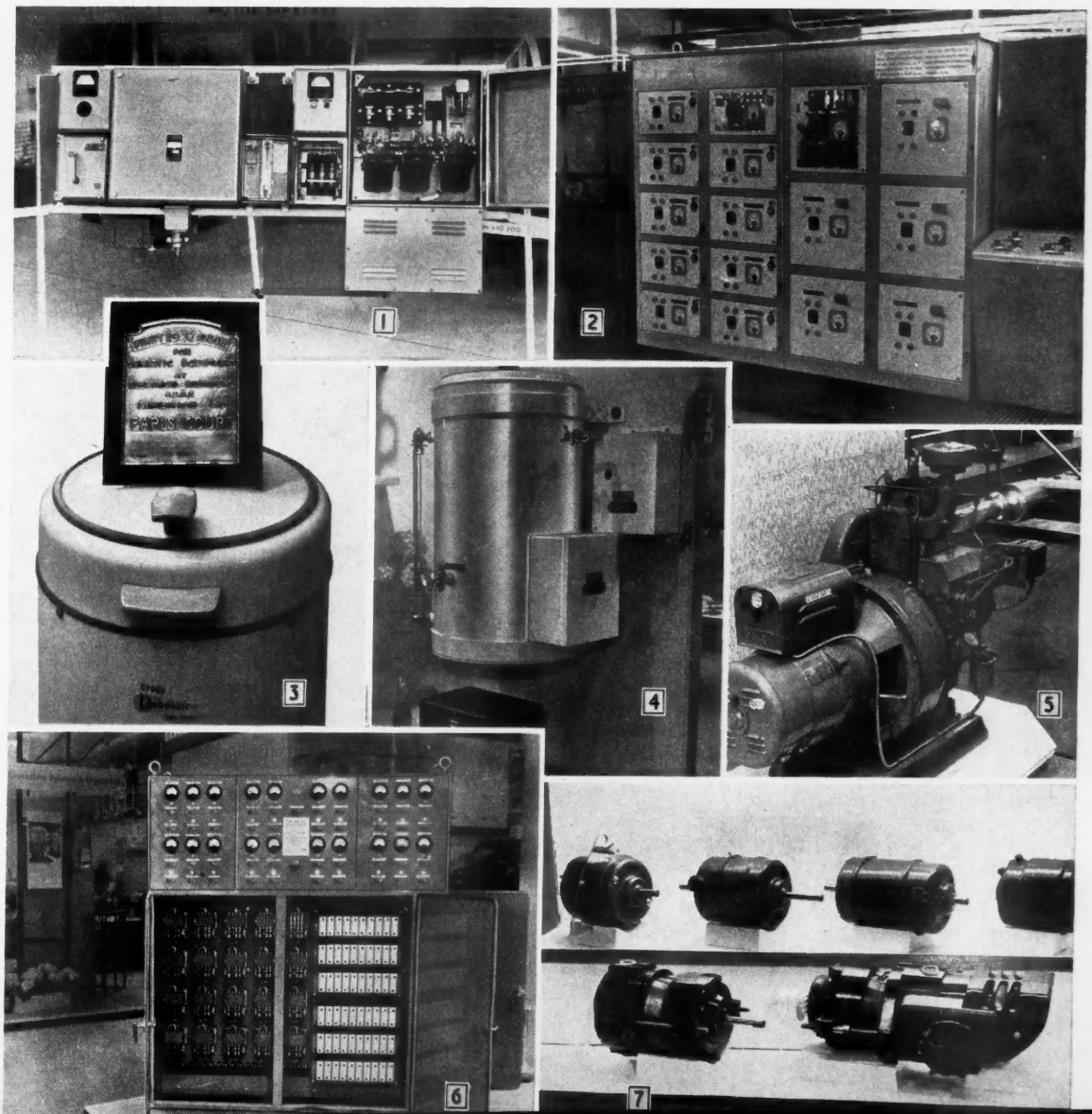
The advent of silicone insulating materials has enabled motor and transformer manufacturers to produce British Standard Class " H " and Class " E " insulated equipment which is capable of operating at elevated temperatures and, in the case of transformers, without using oil with its attendant fire risks. Three years ago no British manufacturer could produce silicone-insulated apparatus, but to-day fourteen concerns are making Class " H " insulated transformers and six showed examples at Earls Court.

In the general field of transformers it was interesting to note that Standard Telephones & Cables, Ltd., who have made countless types of small transformers for many years, have now entered the power transformer business. Present production extends to 50 kVA and is rapidly expanding up to 1 MVA. The range, covering single-phase and three-phase types, includes open, potted, " C "-core and hermetically sealed construction. The company also showed a new unit capacitor system for power factor correction.

Several firms also displayed Class " E " insulated motors. Motors with high power/weight ratios and high overload capacity capable of operating in hot, wet conditions, were demonstrated by Midland Silicones, Ltd., together with dry-type transformers which are virtually fire and explosion proof. The remarkable properties of silicone rubbers which enable them to retain their flexibility and insulating properties over a wide range of temperatures were demonstrated on the stand of Imperial Chemical Industries, Ltd.

Nylon is another interesting material and Hawke Cable Glands, Ltd., demonstrated that it can now be used for protecting electrical fittings against rust or corrosion. Griffiths Bros. & Co., Ltd., introduced a new non-spirit

1. Dorman & Smith motor starters rated up to 40 h.p. 2. Allen West multi-panel contactor board. 3. Prizewinning Creda "Debonair" spin dryer. 4. Heatrae bulk water boiler. 5. Dale diesel generating plant. 6. M.E.M. motor control board for 24-head polishing machine. 7. AC-Delco double-insulated motors



type of finishing varnish, particularly suitable for application by spray as well as by brush, together with an anti-tracking enamel, which is highly resistant to oil and moisture, has excellent gloss and can easily be applied.

The many examples of electric motors which were on view illustrated the diverse applications which have to be catered for and also demonstrated the fact that continuous and vigorous development work is being undertaken to ensure the satisfaction of the user. For example, a high-speed universal appliance motor with Bakelite end frames has been introduced by the AC-Delco Division of General Motors, Ltd., to conform with the many different standards set for household appliances by overseas markets, particularly in Scandinavia. This compact double-insulated motor operates at very high speed and develops an output of up to $\frac{1}{6}$ h.p.

On the B.T.H. stand the type KN-C range of motors of up to 50 h.p. have dimensions in accordance with the proposed draft British Standard dimensions for ventilated motors and, at the same time, incorporate the most up-to-date insulating materials which can safely be worked at higher temperatures than in previous designs. This enables smaller dimensions to be achieved compared with previous practice, and consequently a reduction in price of 12½ per cent can be made. Typical of larger industrial machines Laurence, Scott & Electromotors, Ltd., displayed their N-S motor which is a stator-fed a.c. machine that can be adjusted in speed over a wide range under all loading conditions without brush movement. Its induction regulator (which regulates the speed) may be operated by hand, by remote push-button, or from automatic devices of almost any required type.

A most interesting and promising prototype machine in the form of a brushless variable-speed induction motor was demonstrated by the Metropolitan-Vickers Electrical Co., Ltd. In this machine the effective pole pitch of the stator winding can be changed at will by adjusting the angular position of the two stator core units with respect to the axis of the nearly spherical rotor thus achieving a smooth speed control. The machine demonstrated had been arranged to give a smooth speed control over a 3:1 speed range (i.e. 300 to 900 r.p.m.) but the same principle of construction can be adapted for other ranges of speed.

A new line of generating sets was introduced under the trade name "Rhino" by Dale Electric (Yorkshire), Ltd. Two models were shown, with respective ratings of 3·5 kW and 7 kW, each driven by an air-cooled diesel engine. Each model is divided into three main types, fully automatic, semi-automatic and hand-start, and any of them can be built as stationary or as mobile power units.

Streamlined Switchgear

A streamlining process is slowly but surely having its effect over the whole range of switchgear. Panel construction for l.v. boards is becoming increasingly popular and a number of firms showed attractive examples of what improvements can be made over the old open type with a single busbar chamber running centrally through and switches top and bottom. Panel construction looks better and saves floor space which is always a strong point for industrial applications. English Electric "Superform" is by now well known and was a leader in the field. This company has now introduced "Red Spot" fuseboards to give increased safety to operating personnel, particularly when cabling spare circuits with the busbars alive. Another feature of these boards is the design of the fuse terminals, which cater for both single- or multi-strand outgoing cable.

On the stand of the Midland Electric Manufacturing Co., Ltd., was a compact motor control unit for a 24-head polishing machine. The cubicle houses 49 "Autoline" starters and access for wiring and service is by a double door back and front with an end busbar chamber lining up with a rectangular entry duct in the top of the panel. All outgoing main and auxiliary cables are made to coded terminals. To illustrate their capabilities in the manufacture of heavy industrial grouped starter switchboards Allen West & Co., Ltd., showed a multi-motor contactor assembly with plug-in components and an associated control station governing the movement of the motor-operated letters of the company's name on the facia of the stand. Another was a multi-tier contactor switchboard with positively locking flush doors, individual isolation, neat instrumentation and improved accessibility.

Process Timing

An automatic multi-circuit synchronous process timer type AMT, capable of operating on 230 V or 440 V a.c., was introduced by the Electrical Remote Control Co. It is capable of controlling up to eight separate electrical circuits, the time of each circuit being independently adjustable. The timer resets automatically either at the end of the timing period or on voltage failure and it can repeat its cycle continuously. The switching capacity is 5 A at 230 V a.c. Thermal storage and under-floor heating are rapidly gaining popularity and a number of firms showed equipment for this purpose. For example, M.E.M. had a complete range of control apparatus for under-floor heating systems, while British Klockner Switchgear, Ltd., had some neatly designed control panels for off-peak thermal storage space heating. In a somewhat different connection, a new "Loadmaster" circuit-breaker domestic consumer unit suitable for new or existing installations, and designed to do away with the fuse replacement problem in the home was exhibited by the Dorman & Smith group. They also showed a new range of motor starters for machines of up to 40 h.p.

A bulk water boiler for industrial use in canteens was shown for the first time by Heatrae, Ltd. With a standard capacity of 10 gal the principle of operation is based on a bulk storage of water held at 180 deg F by means of a 4 kW element. When boiling water is required, a second 4 kW element is switched into circuit to achieve quickly the final temperature rise of 32 deg F which only takes a matter of minutes.

In the domestic field the "Thermostor" thermal storage heater of E. K. Cole, Ltd., embody both safety and ease of installation. Safety measures include the provision of a built-in thermostat to prevent overheating, back radiation screens and a sloping top. Simple installation is ensured by easily handled storage blocks and an accessible terminal arrangement with wiring entries from either side or back.

Bells and buzzers included a new "do-it-yourself" bell kit made by V. & E. Friedland, Ltd., to enable anyone to fix a door bell in half-an-hour. Apart from a torch with batteries which can be recharged from a power point or lighting socket Chilton Electric Products, Ltd., had an electric shaver socket capable of accommodating equipment of American, Continental or British voltages. It incorporates a double-wound transformer with an earthed isolating screen, which is protected by a self-resetting thermal trip and a standard glass cartridge fuse.

During the exhibition the first 1957 award for domestic equipment went to the Simplex Electric Co., Ltd., for its Creda "Debonair" spin dryer which was introduced last September. Spinning at 2,500 r.p.m., the capacity of the machine is 6 lb (dry weight) of clothes, which is equivalent to a full washing machine load or a large sink full of washing. It will accommodate a full-size double blanket.

TRADE WITH SPAIN

Plans for Expansion of Power Supply

IN carrying out its policy of self-sufficiency, the Spanish Government has influenced the direction of the country's economy by a variety of controls relating to the allocation of foreign exchange for imports, the distribution of essential raw materials, and the establishment of new industries. It also intervenes directly in industry through the medium of the National Institute of Industry (I.N.I.), a State organisation presided over by the Minister of Commerce and Industry. As raw materials, foodstuffs, fertilisers and oil products alone account for more than 60 per cent of the total value of Spanish imports, little foreign exchange is left for the importation of capital goods.

Because of this shortage of foreign exchange, and Spain's insistence on long-term credits, her electrical imports have decreased during recent years. As a consequence the United Kingdom's electrical exports to Spain during 1955 suffered the substantial drop of £1·1 million on the 1954 figure of £2·8 million, but they recovered to £4·7 million last year. Although the United Kingdom received large orders, including power plant, traction equipment and telecommunication apparatus, the principal competitors, the United States, West Germany, Sweden, Switzerland, and to a lesser extent Belgium, Italy and Holland, in many cases tendered successfully as is seen in Tables 1 and 2, showing the principal supplying countries and main products only. (£1=pesetas 60 to 110).

In view of the vital importance of adequate electric power to Spain, whose power consumption per head is still extremely low, the Government, within the limits of its resources, will give priority, particularly regarding foreign exchange facilities, for the much needed power expansion programmes. Although the bulk of Spain's power supply will be derived from hydro-electric stations, the persistence of near-drought conditions in recent years has served to lay more stress on thermal stations. Production of electrical energy for home consumption in 1956 was 13,750 million kWh, an increase of 13 per cent over the 1955 figure of 12,200 million. Hydro-electric power accounted for 10,800 million kWh and thermal power for

TABLE 1.—SPANISH ELECTRICAL IMPORTS (£ MILLION)

Country of Origin	1954	1955
United Kingdom	2·8	1·7
West Germany	3·8	2·0
United States	1·3	1·1
Sweden	0·5	0·7
Switzerland	1·2	0·6

TABLE 2.—SPANISH ELECTRICAL IMPORTS IN 1955 (THOUSAND PESETAS)

Product and Origin	Value
Steam turbines, 1,000 kg–10,000 kg	1,087
From United Kingdom	43
,, West Germany	323
,, France	378
,, Sweden	103
,, Switzerland	239
Ditto, 10,000 kg–25,000 kg (United States only)	368
Ditto, above 25,000 kg	1,988
From United Kingdom	222
,, United States	1,766
Motors, generators, alternators, transformers, magnetos, starters, rheostats, ventilators, and parts up to 5 kg	2,355
From United Kingdom	213
,, West Germany	312
,, United States	507
,, France	651
,, Italy	212
,, Sweden	197
,, Switzerland	185
Ditto, 5 kg–25 kg	2,038
From United Kingdom	237
,, West Germany	399
,, United States	786
,, France	251
,, Sweden	234
Ditto, 25 kg–100 kg	2,259
From United Kingdom	359
,, West Germany	456
,, France	640
,, Switzerland	348
Ditto, 100 kg–500 kg	4,546
From United Kingdom	477
,, West Germany	524
,, Belgium	212
,, United States	921
,, France	1,881
,, Holland	132
,, Switzerland	216
Ditto, 500 kg–1,000 kg	3,214
From United Kingdom	219
,, West Germany	355
,, Belgium	251
,, United States	282
,, France	1,896
Ditto, 1,000 kg–3,000 kg	3,521
From United Kingdom	387
,, West Germany	438
,, United States	650
,, France	1,553
Motors, etc. (*continued*)	
Ditto, 3,000 kg–5,000 kg	806
From United Kingdom	66
,, West Germany	188
,, United States	225
,, France	268
Ditto, 5,000 kg	25,837
From United Kingdom	4,781
,, West Germany	2,074
,, United States	1,873
,, France	14,037
,, Switzerland	2,423
Complete generating sets and commutators up to 1,000 kg	330
From United Kingdom	12
,, United States	81
,, France	94
,, Sweden	70
Ditto, 1,000 kg–5,000 kg	980
From United Kingdom	439
,, West Germany	169
,, Holland	150
Ditto, above 5,000 kg	2,051
From United Kingdom	246
,, West Germany	241
,, Belgium	551
,, United States	434
,, Holland	156
,, Switzerland	294
Switchgear and switchboards, cut-outs, current limiters, lamp fittings and accessories and installation material weighing less than 200 grams	237
From United Kingdom	24
,, West Germany	33
,, France	63
,, Switzerland	58
Ditto, 200–1,000 grams	326
From United Kingdom	23
,, West Germany	96
,, United States	41
,, France	90
Ditto, 1 kg–100 kg	2,184
From United Kingdom	123
,, West Germany	229
,, United States	417
,, France	225
,, Sweden	233
,, Switzerland	410
Ditto, 100 kg–1,000 kg	2,859
From United Kingdom	241
,, West Germany	428
,, France	1,685
,, Switzerland	278
Switchgear, etc. (*continued*)	
Ditto, 1,000 kg–5,000 kg	1,849
From United Kingdom	286
,, United States	281
,, France	650
,, Sweden	345
Ditto, more than 5,000 kg	3,742
From United Kingdom	563
,, West Germany	724
,, United States	358
,, France	1,975
Indicating instruments, incl. meters	917
From United Kingdom	131
,, United States	272
,, France	188
Stoves, radiators, cookers, and domestic appliances	113
From United Kingdom	49
,, United States	27
Cables and wires, exceeding 1 cm diam.	423
From United Kingdom	101
,, Denmark	143
Ditto, others not exceeding 1 cm diam.	43
From United Kingdom	11
Telegraph and telephone equipment	2,385
From United Kingdom	870
,, West Germany	200
,, Belgium	869
,, United States	151
,, France	169
Radio and TV transmitting and receiving equipment	2,773
From United Kingdom	358
,, West Germany	363
,, United States	488
,, France	243
,, Holland	764
Incandescent lamps, unmounted	1,010
From United Kingdom	97
,, France	469
,, Holland	207
,, Switzerland	124
Mercury vapour lamps	500
From United Kingdom	52
,, West Germany	90
,, Holland	307
Electrodes	3,542
From United Kingdom	16
,, France	3,023
,, West Germany	497
Electric locomotives (mainly from U.K.)	8,773
Electric mining locomotives	260
From United Kingdom	121
,, United States	110

the rest; 520,850 kW of plant was installed during the year. The prolonged drought, which resulted in a fall in reservoir levels to 25 per cent of their capacity, led to the introduction of power restrictions—first in Catalonia and later throughout the country. Among the plans recently announced by the I.N.I. are the first stage of a 62·5 MW thermal station at Vega de Baina and the plant at Burgos. The cost of the former is estimated at pesetas 409 million, of which 248 million will be spent on foreign machinery and equipment. The hydro-electric expansion includes an extension of the La Florida station by 5 MVA, costing pesetas 7·4 million, and the erection of a new station at Poblado de Miller.

The Balearic Islands are faced with supply problems other than occur on the mainland. Since the National Institute of Industry took over the supply and distribution of power in Majorca the strain upon the island's 10 MW thermal power station has been relieved by the construction of a new 30 MW steam plant at Alcuda. This plant, burning locally mined lignite, is independent of outside supplies and will eventually supply the neighbouring islands of Minorca and Ibiza.

Stimulated by the rising private demand and State schemes of power expansion, the Spanish electrical industry, though still small, has been developing on a fairly satisfactory scale. Many of the larger firms work under manufacturing agreements with well-known United States, German or French companies. The trend is not only to widen the manufacturing programme, but also to produce larger equipment. Production includes motors, alternators, transformers, switchgear, water turbines, cables, telecommunication equipment and insulators.

High-Temperature Heat Treatment Furnaces

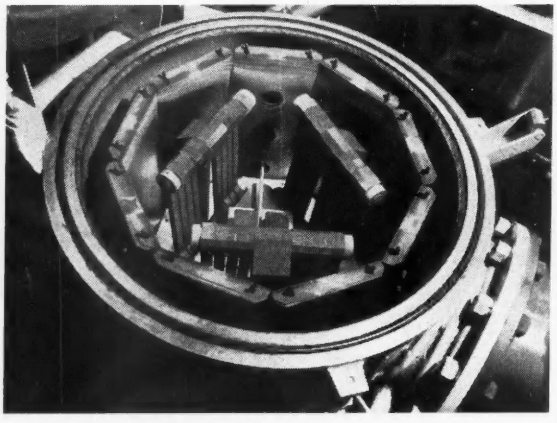
GRAPHITE resistor heat treatment furnaces capable of providing temperatures up to 3,000 deg C have been developed by the General Electric Co., Ltd., in meeting the demand created by development work on atomic energy, guided weapons, and supersonic aircraft, for high temperatures required in the heat treatment of the new metals—titanium, tantalum and zirconium; for sintering; and for brazing components which will operate at elevated temperatures.

One of the first of these new high temperature furnaces has been installed in the B.S.A. Group Research Powder Metallurgy Laboratory at Small Heath, Birmingham. Designed to give temperatures up to about 2,000 deg C and to maintain a good vacuum for the protection of a charge from oxidation, this furnace is to be used for sintering materials for use at high temperatures.

The body of the furnace is a water-cooled, vertical, cylindrical steel tank with a hinged, domed lid. A vacuum-tight seal is formed between flanges on the lid and the furnace body. The charge is heated by radiation from a triangular-shaped assembly of graphite bars which surrounds the charge space, and these graphite bars are fed at a low voltage by a three-phase transformer. A voltage regulator enables the secondary voltage of this transformer to be steplessly varied to give control over the heating rate.

Radiation screens consisting of molybdenum sheets so arranged as to enclose the heating chamber, provide the thermal insulation. With the furnace lid raised the top radiation screen can be lifted to give access to the chamber.

The element assembly and side radiation screens of the new 2,000 deg C vacuum furnace installed at the B.S.A. works



The charge is supported on a graphite tripod. The vacuum pumping system consists of a gas ballast pump, a combined booster and an oil diffusion pump, and a valve block which controls the evacuation of the furnace chamber.

The valve block is fitted with a five-position operating lever which can be moved only in one direction to ensure the right sequence of operations. With the lever in position one, air is allowed into the furnace chamber and the pumps can be switched on. In position two, the chamber pressure is reduced by the coarse pump, and this evacuation continues in lever position three, which is similar to lever position one except that air is not allowed into the chamber until the pressure has been reduced to 0·05 mm mercury. With the lever in position four, the diffusion pump continues the evacuation until the required pressure is reached. An operating vacuum between 10^{-4} mm and 10^{-5} mm mercury can be obtained. When the lever is in position five, all valves are closed so that the furnace chamber is isolated from the pumping system, and leak-rate tests can be made.

Safety devices give protection to both the furnace and the charge against possible failures in the electric and water supplies. Warning of an electric supply failure is given by an audible alarm. In the event of a fault occurring in the water cooling system flow, relays cause an interruption in the power supply to the furnace. An indicator lamp in each cooling circuit simplifies location of a fault.

The maximum rating of the furnace is 120 kVA, and the furnace will accommodate a charge of about 9in diameter and 12in high with a maximum weight of 90 lb. With an alternate element arrangement the charge space can be increased to 11in diameter by 11in high. Provision is made for introducing a hydrogen atmosphere into the furnace chamber to hasten the later stages of cooling. In this way when using the furnace for brazing a 50 per cent reduction in cooling time can be obtained. Similar furnaces are made with loading dimensions 4in diameter by 6in high (for laboratory use) and 15in diameter by 24in high.

I.E.E. Scottish Centre

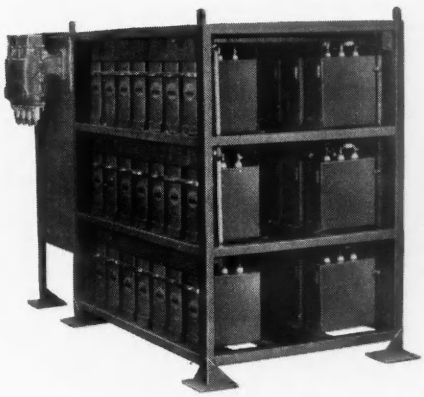
The spring meeting of the Scottish Centre of the Institution of Electrical Engineers will be held from 24th to 27th May at the Pitlochry Hydro Hotel, Perthshire. The programme will include a golf competition for the Hutcheson-Winning cup, a visit to the hydro-electric scheme of the North of Scotland Hydro-Electric Board at Gaur, and a visit to Pitlochry Festival Theatre, or, alternatively, dancing in the hotel ballroom. Applications to attend should be made to Mr. J. H. P. de Villiers, hon. secretary, I.E.E. Scottish Centre, c/o Bruce Peebles & Co., Ltd., 19, Waterloo Street, Glasgow, C.2, by 17th May.

NEW ELECTRICAL EQUIPMENT

"Therminol" Capacitors

The "Therminol" capacitors introduced by A. H. HUNT (CAPACITORS), LTD., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18, represent an advance in capacitors for power factor improvement. The special non-inflammable impregnant and coolant employed has a high dielectric constant which enables smaller dimensions to be achieved without loss of dielectric strength, but with economy in price compared with normal oil-impregnated types. The capacitors can be operated at ambient temperatures up to 60 deg C.

The initial range covers values up to 21·5 kVAr and the construction is such that with the reduced sizes the units are also eminently suitable for racking up into banks to a large value of kVAr.



Hunt L90A "Therminol" capacitors. Typical example of racking assembly

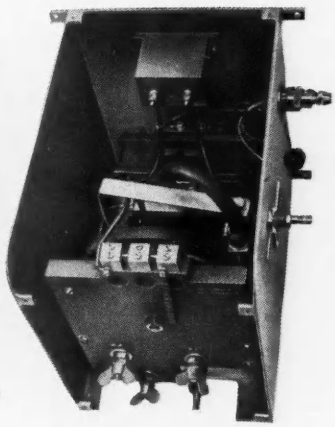
H.F. Injector for Arc Welding

When welding by processes using an electric arc it is sometimes desirable to start the arc without allowing the electrode to touch the workpiece. It is also found that some combinations of electrodes, shielding atmosphere and composition of parent metal require an o.c. voltage higher than the safe limit, to maintain a stable arc. The injector manufactured by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17, provides a solution to both these problems by superimposing a high voltage on the output of the welding transformer or generator at a frequency sufficiently high to remove danger of electric shock.

The equipment consists of a high-voltage transformer with a secondary output at 4,000 V, a capacitor, a double spark gap with tungsten points and a water-cooled air cored transformer to inject the high frequency voltage into the welding circuit while isolating the power frequency high voltage from it.

The secondary winding of the air cored transformer carries the full welding current and is suitable for 400 A continuous, or 450 A on intermittent duty. The power consumption of the unit is 100 W.

This unit can also be used in conjunction with a Metrovick flow control unit for inert-gas arc welding. In such cases a relay is fitted so that a single push-button switch operates both units.



Metrovick high-frequency injector for arc welding (with sheet metal cover removed)

Welding Oil Storage Tanks

Automatic girth welding equipment for the simultaneous welding of internal and external circumferential seams of oil storage tanks from 30ft to 200ft in diameter, *in situ*, is being manufactured by QUASI-ARC, LTD., Bilston, Staffordshire. The time taken with this new equipment is much less than with normal manual welding methods. With the girth welding equipment the tank is constructed vertically, strake on top of strake, instead of horizontally as is usual with smaller vessels.

The equipment consists of two "Unionmelt DSH" welding heads with control panels and platforms for two operators. These are mounted on a saddle-type carriage which straddles the top strake of the tank. The drive and idler wheels of the carriage run directly on the curved edge of the plate and guide rolls are provided to act as a pivoting device.

Thus there is one welding head inside the vessel and one outside, with an operator on the platform of each. As the carriage moves at the selected welding speed round the perimeter of the tank, the internal and external seams are welded simultaneously and continuously in the horizontal position. Vertical adjustment of the welding heads allows for plate widths from 4ft to 9ft with additional local adjustment of 12in for accurate positioning of the welding heads. A spotlight device enables the operator to guide the welding nozzle accurately along the joint. The carriage movement is remotely operated from the operators' control panels and speed indicators are fitted.

The "Unionmelt" welding composition is supported under the welding nozzles by an endless belt arrangement, tilted so that a weight of composition presses against the joint. Support is thus provided for the molten weld metal so that welding currents up to 750 A can be used.

A continuous melt circulation system recovers the unfused composition and feeds it back to the hopper at the top of the machine. It then falls by gravity back to the welding nozzles. Removal and repositioning of the equipment for the succeeding strake is simple and rapid.

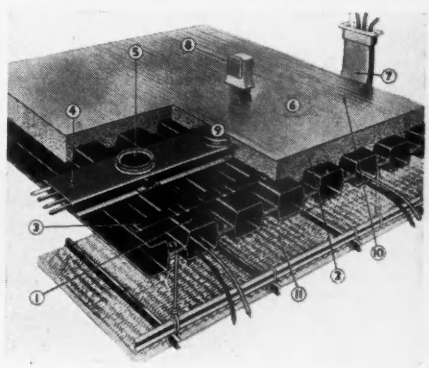
The equipment can be used for plate thicknesses from ¼in to 3in or even greater in some cases. The variable speed of welding ranges from 20in to 45in/minute. Using ⅛in diameter wire at 500 A the metal deposition rate for each welding head is approximately 0·25 lb/min.

Floor Wiring System

The "Q-Floor" wiring system has been introduced to this country by ROBERTSON THAIN, LTD., Ellesmere Port, Wirral, Cheshire, who are marketing a range of electrical fittings which enable the cells of their structural steel floor to be used as wiring ducts. The illustration shows the method by which cables are brought by means of cross header ducts to the cells of the floor through which they run to outlets above and below the floor.

"Q-Floor" wiring system (Robertson Thain)

The items identified by the numbers in the photograph are as follows:—1. Cellular steel "Q-Floor" unit 2. Structural concrete topping. 3. Bonding anchor. 4. Header duct. 5. Header duct junction unit. 6. Tray containing floor finish, covering junction unit. 7. Rising connector between header duct and distribution board. 8. Lighting, power or telephone floor pedestal outlet. 9. Blanking-off disc. 10. Floor finish. 11. Suspended ceiling



Deep Electrolytic Tanks

THE design, construction and operation of an electrolytic tank for accurate analogous solutions of complex three-dimensional field problems formed the subject of a paper presented on 9th April before the Measurements and Control Section of the Institution of Electrical Engineers by Messrs. E. R. Hartill, J. G. McQueen and P. N. Robson (Metropolitan-Vickers Electrical Co.). The main object was to solve three-dimensional potential problems insoluble by conventional analytical methods. This had entailed the use of a deep tank, measuring 6ft by 4ft internally with a 3ft effective depth of water, together with facilities for plotting and recording the potential distribution at any plane. Two-dimensional problems were also catered for by means of a false bottom to the tank. A further development now required was said to be a thin conducting boundary layer for separating electrolytes of different conductivities to permit the study of the effects of mixed dielectrics.

The discussion was opened by Mr. J. G. Yates (University of Cambridge), who referred to the use of tap water and said he liked a resistivity of something like 10,000 ohm/cm^3, which was a compromise between not wanting to get it too high, because then the probe impedance became too large and the effect of stray capacitance was a nuisance, and not wanting it too low as that caused a great deal more trouble. The Cambridge tap water was about 2,500 ohm/cm^3 and consequently he did not use it, but used instead one of the readily available de-ionisers, which would give an appreciably lower conductivity, and then either put in a drop of acid or mixed back some tap water.

To avoid emptying the tank every few days all he did was to remove the dirt occasionally. On the subject of probes, the authors were to be congratulated on their solution of painting the silicone varnish round the probe but not right up to the tip.

Mr. J. W. Gallop (Medical Research Council) said he was interested in what gave rise to the tank historically, namely, the proton linear accelerator, and he wondered why the authors went to an electrolytic tank rather than computing by means of relaxation techniques.

Mr. J. K. Webb (Standard Telephones) recalled a method which had been described some years ago in a paper entitled "The Use of a Rubber Model for the Solution of the Laplace Equation," the general idea being that one stretched a large rubber membrane like the top of a drum and represented potentials by pushing it up from underneath. Then, to get the lines of flow, steel balls were rolled down the slopes. One then could shine a light across it and the equal potentials showed up like the contours of a map.

Mr. P. A. Einstein said he was interested in the problem relating to the insulator and believed it might be possible to solve it more exactly by replacing the insulator not by an insulating material in the tank itself but by some material which bore to the tap water a conductivity ratio similar to that which the insulating material bore to the air in terms of dielectric constants.

Mr. P. H. G. Allen said that in the electrolytic tank one had to inject currents very often and he himself used 1,000 c/s sinusoidal and found it convenient to use the Boucherot circuit. It merely consisted of an inductor and a capacitor, the main point being that there had to be a fairly good Q factor. One advantage was that constant currents were fed into the bath and voltages could be generated which were convenient for measuring purposes. It was his custom to mix distilled water with local tap water, and found a fifty-fifty mixture satisfactory.

E.D.A. Sales Conference

THE final session of the Annual Conference of the Electrical Development Association held last week was at the Connaught Rooms on Friday. After a morning in which delegates had the opportunity of airing their views, they attended the conference luncheon over which Mr. V. W. Dale presided in the absence of Mr. D. Bellamy.

Mr. Dale, who recently retired as director of the Association, described himself as "minister without portfolio." He spoke of some of the important events of the week—the Queen's visit to France, from which much could be learned about salesmanship, the A.S.E.E. Exhibition, the coincidence of which with the Conference was timely, and the Budget, which had taken a little of the tax off some goods, but had yielded nothing to the electrical industry. He said that the day of full automation was not yet and the work of the selling side of the industry was still important. It would be a mistake to be smug because they were in the best industry in the world, and they would have to keep on their toes. In reminiscent mood, Mr. Dale referred to some of the Association's past achievements and its disappointment that some of its schemes, through causes outside its control, had not materialised. He said that the industry still had a tremendous future. He paid tribute to all who had contributed to the success of the Conference, and in proposing a toast to Mr. J. I. Bernard, his successor as director of the Association, wished him every success. Mr. Bernard briefly responded.

Lord Chandos, president of E.D.A., delivering the opening address at the annual conference. Also in the picture (left to right) are Mr. D. Bellamy (chairman, E.D.A.), Miss Mary George (director, E.A.W.), and Mr. V. W. Dale

BROADCASTING TRANSMITTER CONTROL

Economy Through Remote Operation

IN his chairman's address to the Radio Section of the Institution of Electrical Engineers in October, 1949, Mr. R. T. B. Wynn referred to the steps being taken by the B.B.C. to extend its sound broadcasting service without proportionate increase in the number of its technical staff. This is now being done through remote and automatic control of transmitters which are semi-attended, i.e. not normally manned, but having staff on call who are engaged on other duties or living nearby. In an integrating paper presented before the same Section last week, Mr. Wynn, in association with Mr. F. A. Peachey (also of the B.B.C.), described the results so far obtained with 67 m.f. and v.h.f. transmitters operating without continuous supervision. The technique adopted, which varies with the importance of the station, has saved 200 men and more than £100,000 per annum in salaries.

Of the total loss of transmission time of 0·132 per cent (covering line faults, power failures and faults within the stations), only 0·0093 per cent has been due to causes local to the transmitters, which compares with 0·019 per cent for fully attended transmitters. These results have been achieved through ensuring that each piece of apparatus is of the greatest possible reliability. In the limit completely reliable transmitters would need no monitoring equipment and would therefore be free from faults on such apparatus. This form of automation has made possible the provision of services otherwise economically impracticable to small pockets of population and also the giving of nation-wide v.h.f.-f.m. coverage with the minimum of staff.

In a companion paper Messrs. W. J. Morcom and D. F. Bowers (Marconi's Wireless Telegraph Co.) gave particulars of the design of two medium-frequency transmitters, one rated at 660 W and the other at 100 kW. The smaller units are paralleled to give a 2 kW fully automatic station, while two 100 kW sets make up the semi-attended station at Daventry, which radiates the Third Programme at 647 kc/s at a power that is limited to 150 kW in conformity with international regulations. At the smaller station no moving machinery is installed, cooling being by convection, and metal rectifiers are employed; no relays are used in the combining circuit because that is common to all transmitters and a failure might then put the station out of action instead of giving a field strength in direct proportion to the number of transmitters still functioning. At Daventry, air cooling, a.c. heating of filaments and improved arc rectifiers are employed. Automatically controlled h.f. contactors bypass the combining circuit should one transmitter fail, so that the full power of the other can be supplied to the aerial.

DISCUSSION

The discussion on the two papers was opened by Sir Harold Bishop (B.B.C.) who referred to the paper by Wynn and Peachey, and said he would have liked a clearer statement of the justification for the very considerable design work involved and the capital cost of all the equipment described set against staff savings, improved performance and so on. One had to take into account the heavy cost of running the mobile maintenance teams.

Other countries had similar automatic arrangements but they were not, by and large, so complicated as the ones the B.B.C. had adopted. Other equipment was generally confined to simple indications of whether the transmitter was on or off, modulation level, etc. He wondered whether the arrangements adopted by the B.B.C. were not a little too complicated and perhaps too costly. There was great importance in extending the unattended technique to television transmitters, and he hoped that a number of unattended television transmitters would be built to cover badly served areas.

Mr. B. N. MacLarty (Marconi's) said that the principle of using transmitters in parallel was pioneered by the B.B.C. in 1941. He was horrified at the idea of using transmitters kept permanently in the switched-on condition and felt that transmitters could be supplied which would stand up to the shock of being switched on and off.

Television Boosters

Capt. C. F. Booth (Post Office) said that the application to television boosters would be very important up to a point for Band 1 and even more so for Band 3, and when they got to Bands 4 and 5 they would have to rely, in order to get national coverage, on a very large number of unattended stations which might be of relatively high power.

Dr. A. J. Biggs (G.E.C.) said he thought that the application to television would not be much more difficult than the sound problem. With sound, very low levels of distortion had to be achieved, whereas with television a little more waveform distortion could be tolerated.

Mr. A. H. Beck (Standard Telephones) said that the paper by Wynn and Peachey stated that it was impracticable to provide duplicate aerials. On the basis that probably the most reliable transmitter equipment consisted of two transmitters each with its own aerial and separate power supplies, such a statement seemed a pity. The latest semi-attended station in Scandinavia, that at Stockholm, used a duplicate aerial system, and was the first example of a split aerial being fed by two equal power transmitters.

Mr. J. Rhodes (Post Office) drew attention to the long distances over which some of the transmitters were controlled, between 100 and 250 miles, and said that many of the routes had not been planned to provide a high quality broadcast circuit and various non-standard arrangements had to be adopted to provide the circuit. They had not got to the stage where they could provide parallel lines over those long distances, but if that were done the lost programme time, on the basis of the figures given in the paper, would be improved at least forty-fold.

Sir Noel Ashbridge said he was worried by the figure of 0·06 for time lost due to power failures. He wondered whether it meant that power circuits before the war were much better than present circuits or whether the figure included a very big breakdown, perhaps due to a fire.

Mr. R. Petre said that in the B.B.C. Overseas Service, when programmes were switched at exact multiples of each quarter-of-an-hour, and as the instant second of switching must be observed, further automation might be introduced. Master clocks at the main studio centre and the transmitting stations might be kept in step over very long periods to within ±1 sec by using Greenwich time signal corrections, which were always available. Uni-

selectors might then be pre-marked for every programme throughout the day and switched by impulses from the clock.

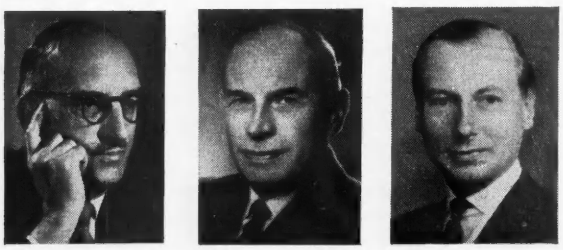
Mr. H. Stanesby said he was surprised that it should have been decided to operate three low power transmitters in parallel. It might be because it derived from an earlier system in which there were 10, but with reliable transmitters he would have thought it unnecessary to cater for the possibility of two failing simultaneously. With radio relay systems, it was found better to leave the equipment continuously switched on. Changing to that situation from switching on and off, they had found the number of faults reduced to less than half the previous number.

Mr. J. M. Chorley said they had been given a demonstration of a telephone indicator panel sending back information from a transmitter to a staffed centre. He wondered whether there was a device which could do the reverse and send information to the transmitter to get some action initiated, such as when it might be necessary to extend the transmission hours beyond the normal time.

Manufacturers' Meeting

Mr. E. H. Ball's Address

IN our last issue we reviewed the 1956-57 report of the British Electrical and Allied Manufacturers' Association. The report was presented at the annual meeting on 11th April by Mr. E. H. Ball (B.T.H. Co.), chairman of the B.E.A.M.A. Council, who in the course of his remarks emphasised that the B.E.A.M.A. was a non-profit-making organisation which served to provide co-operative effort in matters in which such action was better than individual endeavour. Without the Association the industry could only present a chaotic front to political and economic conditions. He commended the work of Col. B. H. Leeson, the director, Mr. D. Maxwell Buist, export



Sir Vincent de Ferranti, the new president; Mr. J. O. Knowles, chairman of Council; and Mr. W. K. G. Allen, vice-chairman

director, and Mr. James Oldroyd, secretary, and the Association's staff, and also thanked the immediate past-chairman, Mr. D. D. Walker, and the vice-chairman, Mr. J. O. Knowles, for their assistance during his two years of office.

The industry had reached a climacteric point in its history and was entering upon a new era for which it had to equip itself. In a comment on the role of industrial administrators Mr. Ball said that they had to serve many conflicting interests; they were expected to make profits to finance essential services and at the same time they were vilified for profit making.

Mr. Ball said that the Institution of Electrical Engineers was the midwife at the birth of technical ideas and the B.E.A.M.A. performed a similar service for industrial and commercial ideas. About nine-tenths of its work was non-controversial but it was the remainder that received public attention. The public interest, he insisted, was always in the Council's mind. The industry would have a very great future if its problems were surveyed from the aspect of the B.E.A.M.A. and its Council.

Finally, Mr. Ball announced that Lord Chandos was being succeeded as president of the B.E.A.M.A. by Sir Vincent de Ferranti. The new chairman was Mr. J. O. Knowles (Brookhirst Switchgear, Ltd.) and the vice-chairman Mr. W. K. G. Allen (W. H. Allen, Sons & Co., Ltd.).

Another Transatlantic Telephone Cable

OFFICIALS of the Governments of Canada and the United Kingdom, together with representatives of Cable & Wireless, Ltd., and the Canadian Overseas Telecommunication Corporation, met in Ottawa recently to consider the development of transatlantic telephone and other telecommunications services.

The first telephone cable, between the United Kingdom, Canada and the United States, was opened for service in September last. Although it represented a most notable advance in transatlantic telephone communications, the maximum capacity that could be provided was limited for technical reasons. The high quality of the service has led to a greatly increased volume of traffic. In fact, telephone traffic between Canada and the United Kingdom has trebled in six months.

Advances in techniques since the existing transatlantic cable was planned will enable future cables to have greater capacity. With the rapid economic development of Canada, the prospect is that traffic will continue to grow rapidly. Interim measures were explored with the object of meeting the immediate situation. It was agreed in principle by the officials that a new submarine cable, incorporating the techniques at present under development, should be provided as quickly as possible between Canada and the United Kingdom. This would accommodate many more circuits than any existing cable of comparable length.

Provisional plans to this end were agreed in the discussions for further consideration by the two Governments concerned. The new cable could be an important link in the Commonwealth system as a whole and the next step will be consultations with other Commonwealth countries. It is expected that the cable could be completed by 1961 as a joint undertaking by Cable & Wireless, Ltd., and the Canadian Overseas Telecommunication Corporation.

Heavy-Duty Cooking Equipment

SPECIFICATIONS covering the whole range of heavy-duty cooking equipment, compiled by the Standard Interdepartmental Committee on Heating in Government Buildings for use by Government Departments, have been published by the Ministry of Power (Ref. HGB5 1957, H.M. Stationery Office, price 9s). They are intended to replace the specifications in the Ministry of Works publication "Cooking Appliances—Schedule of Types" which was originally prepared with special regard to wartime conditions.

The present specifications are designed to provide thoroughly satisfactory appliances from the point of view of cooking, high fuel efficiency and sound construction. The sizes and capacities of the respective items of equipment detailed are those found to be most used in both industrial and non-industrial canteens and restaurants and are given as a guide to kitchen planning and production of equipment. As much general information as possible has been covered in a foreword, so that individual specifications can be kept brief. Acknowledgment is made of the advice and assistance received from the Gas Council, the Central Electricity Authority, the British Electrical and Allied Manufacturers' Association, the Catering Equipment Manufacturers' Association and other trade bodies.

GENERATION AND DEVELOPMENT

North Western Tariff Changes

As briefly reported in last week's issue, the North Western Electricity Board is to increase its charges. In addition, new standard tariffs for commercial, institutional and smaller industrial consumers are being introduced. The changes will apply in respect of electricity used after the first normal meter reading following 30th June.

In announcing the alterations the Board stated that they were based on costs estimated in the light of information available in January last. The higher bulk supply tariff since published would cost the Board £550,000 more in 1957-58 and £1,180,000 in 1958-59, and the tendency was still evident for other costs to rise. Nevertheless, it was the determination of the Board, through increased efficiency and expanded sales, to do everything possible to stabilise prices for a further twelve months, i.e., to 31st March, 1958.

Under the domestic and farm tariffs the 5d rate is to be raised to 5½d and the 0·9d rate to 1d. Domestic prepayment consumers will pay 6½d instead of 6d per kWh and the quarterly fixed charge to farm consumers will go up by 10 per cent. Industrial consumers taking supplies at medium voltage will pay the equivalent of 1s 9d a month more per kW of maximum demand and there will be corresponding smaller increases for high voltage supplies.

The new standard commercial tariffs, which replace over 450 forms of tariffs, fall into four broad groups, as follows:—

Flat-Rate Tariffs.—Lighting: 5½d/kWh. Heating and motive power: First 240 kWh quarter, 2½d/kWh; all in excess, 1½d/kWh.

All-Purpose Block Tariffs.—Primary block (based on the installed lighting load) at 5½d/kWh; secondary block (based on (a) the installed lighting load; (b) cooking and water heating load; and (c) motor or other load) at 2½d/kWh; and all additional consumption at 1d/kWh.

In the case of places of worship, the number of kWh chargeable at 5½d and 2½d will be halved provided that the use of electricity is as defined in the tariffs.

Maximum Demand Tariff.—Annual charge based on the highest measured maximum demand during the year, and "unit" charge graded from 0·71d to 0·63d, dependent on the number of kWh consumed per kW of m.d., subject to a fuel price variation charge of 0·0007d/kWh for each 1d increase or decrease in the price of coal from 60s/ton.

Off-Peak Tariff.—Overnight storage space heating for commercial and institutional premises, 0·825d/kWh.

Farm Electrification

The North Eastern Electricity Board is to commence work on the supply of electricity to nearly 50 farms in the Marwood and Langley Dale areas of Barnard Castle.

Calder Hall Output

During February generation at Calder Hall nuclear power station resulted in a net export to the grid at Windscale of 3,438,000 kWh.

New Scottish Grid Supply Points

A scheme costing approximately £2 million which provides for the establishment of two new grid supply points at Elderslie and Crookston connected by overhead lines to a new 132 kV switching station at Neilston, and for the construction of six new substations, has been approved by the South of Scotland Electricity Board. The new switching station will be fed from the grid system. The work is scheduled for completion by 1960.

The scheme forms another stage in the Board's plans for relieving Yoker generating station of part of its ever increasing load. As an earlier part of these plans, grid supply points were established at Strathleven and Killermont and one is under construction at Renfrew Ferry.

It is estimated that the demand in the area at present supplied from

Work is proceeding rapidly at the site of the Berkeley (Gloucestershire) nuclear power station being built for the C.E.A. by the A.E.I.—John Thompson Nuclear Energy Co., Ltd. This view, taken two weeks ago, shows the excavations for the two reactors. No. 1 reactor pit in the foreground is in the process of being concreted; the indentations around the pit will take the bases of the heat exchangers. To the left is the excavation for the turbine hall and in the right foreground is the pressure vessel erection slab. The camp in the background is temporary accommodation for some of the men employed on the site

New fluorescent lighting in Shaftesbury Avenue, London. Mazda "Diadem" lanterns, each housing four 80 W fluorescent lamps, are mounted at a height of 25ft

Yoker station will have increased by 50 per cent between now and 1960. The station, which has an installed capacity of 100 MW, was commissioned by the former Clyde Valley Electrical Power Co. in 1905.

Progress in "Manweb" Area

During the year ended 31st March last 27,000 new premises were connected to the supply by the Merseyside and North Wales Electricity Board, including 24,000 domestic premises and over 1,400 farms. To provide new supplies and reinforce existing cable networks, the Board laid 948 miles of new mains and commissioned 1,185 new substations. Electrical appliance sales, valued at £1½ million, were slightly less than in the previous year. Five new electricity service centres and one special centre devoted solely to industry were opened.

Fluorescent Lighting in Shaftesbury Avenue

The last of the gas lighting in Shaftesbury Avenue on a section between Piccadilly Circus and Cambridge Circus has been replaced by lighting from an installation of the latest type of fluorescent lanterns on steel columns. The installation is unusual not only for its very high level of illumination but also because it gives continuity of fluorescent lighting from many different installations starting at Old Broad Street in the City through High Holborn and Piccadilly to Kensington High Street, a distance of about five miles.

Altogether some forty Mazda 5ft "Diadem" lanterns, each housing four 80 W "new warm white" fluorescent lamps, have been installed at opposite intervals of 120ft and mounted at a height of 25ft on specially designed steel columns carrying the Westminster City Council monogram.

Features incorporated in the lantern include a corrosion-resistant aluminium canopy and a smooth one-piece "Perspex" cover bowl free from drilling or riveting. The illumination level is approximately 16,000 lumens per 100ft of roadway, even brighter than the 13,000 lumens of the Kensington Road scheme installed recently. By comparison the normal maximum laid down by the British Standard Code of Practice is 7,000 lumens per 100ft of roadway. The erection contractors were Clough Smith, Ltd.

OVERSEAS

Refrigeration at Kariba Dam

The purpose of controlling the temperature of the concrete in a dam is to regulate the volume change and thereby prevent or control the formation of shrinkage cracks in the structure. Climatic conditions in the Kariba Gorge make artificial cooling essential if the dam there is to be built within the specified period.

Two methods are available: the cooling of all the ingredients which make up the concrete before it is poured, or the cooling of the mass of concrete after pouring.

At Kariba cooling of the concrete after pouring has been selected. To achieve an even rate of cooling in the interior of the dam wall it is proposed to embed about 400,000ft of piping in which cold water will circulate. When concrete pouring reaches its maximum the cooling required will be roughly equal to the melting of 900 tons of ice a day.

The main contractors, Impresit, Ltd., of Milan, called for international tenders and eventually the contract for the supply of refrigeration plant was awarded to Johnson & Fletcher, Ltd., of Salisbury, Southern Rhodesia, for equipment made by the Carrier Corporation of America. The refrigeration plant consists of five compressors, each driven by a 200 h.p. motor. Each machine uses a heat exchanger which consists of a nest of tubes within a cylindrical shell where the cooling medium evaporates and thereby extracts heat from the water being pumped through the tubes. Chilled water to the dam is then circulated in a closed system. It is, of course, possible to run only a few of the machines at any given time to provide just enough cooling for the work being carried out.

Water Power in Basutoland

The Durban correspondent of *The Times* states that survey work is now in progress for an £18 million hydro-electric project on the upper reaches of the Mabbamatso River in Basutoland, one of three large schemes being investigated by the British Government. The Mabbamatso project involves tunnelling through a range of mountains. It would produce 350 million kWh annually. A second proposal is for the construction of a 400ft dam on the Caledon River and a third, costing £45-50 million, concerns the Orange and Semena Rivers.

New Zealand Geothermal Power Plans

Geothermal development at Wairakei to produce 252 MW at a cost of £21,680,000 has been recommended to the New Zealand Government. This production is equal to a quarter of the country's present resources. Stage 1 of the work, to produce 69 MW, is now in hand at an estimated cost of £7,773,000. Stage 2 will be the building of a second generating station to produce a further 82 MW, the cost being £6,586,000, and Stage 3 will be the production of another 101 MW in the Stage 1 building, the cost of this being estimated at £7,321,000.

The report of the London consultants, Merz & McLellan, proposes that both steam and hot water should be used for the production of electricity, "although the utilisation of the hot water is technically difficult." It is pointed out that the power potential of the hot water bore is perhaps 65 per cent or more of the power potential of direct steam, but collection and piping present considerable technical difficulties. These could be overcome, however, and the use of the water could be well justified.

North-South Link

Cables across Cook Strait to link the New Zealand North and South Island power systems are regarded by British Insulated Callender's Cables, Ltd., as "thoroughly practicable." The company has recommended d.c. cables operating at 250 kV, and the initial proposal provides for the transfer of 600 MW—half as much again as the present South Island generating capacity, while the plan calls for

eventual doubling of the transfer to 1,200 MW.

For the first stage it is recommended that the cable should run from Oteranga Bay, at the southern end of the North Island, to Fighting Bay on the South Island, a distance of 25½ miles. Two cables and one spare would be needed for the first d.c. link, compared with the 12 cables and two spares which would be required for equivalent transmission by a.c.

The main points made in the B.I.C.C. report to the New Zealand Government are: There are several suitable routes for the cables, for in the area recommended the bottom of Cook Strait has been shown to be reasonably flat and largely free from rock. There are no precipitous cliffs or crevices and the maximum gradient does not exceed 1 in 5. There is a zone about seven miles wide in which the depth of the water is not greater than 900ft. The rugged coasts limit the choice of landing sites for the cable, however. As the weather in the strait is very changeable, the time for laying each cable must be less than 24 hours.

The estimated time for the manufacture and laying of the three d.c. cables is 13 months, but much preparatory work will have to be done and proving tests made. The cost of the complete system would be about £16 million for d.c. compared with nearly £26 million for a.c.

100 kV Cable Installation in Bombay

On 4th April the switching-in of Asia's first 100 kV impregnated pressure cable installation took place in Bombay. These cables were supplied and installed by British Insulated Callender's Cables, Ltd., for the Tata Power Co., Ltd. The cable is used to connect a new receiving point in Bombay with the rest of the 100 kV system.

Early in 1955 the Tata Power Co. awarded B.I.C.C. the contract for the supply and installation of over 16,500 yd of 3-core 100 kV impregnated pressure cables. It was finally decided that the installation should consist of two 3-core cables, each capable of carrying up to 90 MVA, laid together through 4½ miles of streets in the Bombay Port area from Sewri Fort to the new Carnac receiving station.

Installation work commenced in October, 1955. Owing to the climatic conditions, no work was possible during the heavy monsoon rains and operations were, therefore, stopped in June, 1956, to be started once again in October of the same year. The installation was completed by the end of the year and both cables were charged in January, 1957. However, the final switching-in was delayed until the completion of the receiving station at Carnac.

High temperatures and excessive humidity, which are features of the Bombay climate, made it desirable that all jointing should be carried out in a controlled atmosphere. In order to achieve this, specially designed portable jointing tents were constructed locally of a heat-insulating material and two 1-ton air conditioners were fitted in each joint bay. The aluminium mobile site office, too, was fully air conditioned. Power for air conditioning, lighting and general purposes was supplied by a number of mobile diesel generator sets.

Power Supply in Andhra

We have just received from the Andhra Electricity Department, India, a copy of its first annual report, covering the year 1953-54. Andhra State has an area of over 63,500 square miles and a population of 20½ million. Broadly, it consists of all that territory of the Province of Madras to the north of the city of Madras and west to Mysore. Known as the "River State," it has some 15 per cent of India's total water resources but is industrially backward. The per capita consumption is only about 5 kWh a year. The 35,000 kW of generating plant in the State at the date of the report was thermal and diesel, augmented by a bulk supply of 6,000 kW from hydro-electric schemes in neighbouring States. Two hydro-electric schemes are, however, under construction: the Machkund project, which commenced operation in 1955 with an initial capacity of 51,000 kW, and the Tungabhadra joint scheme with Mysore, the first stage of which is due for completion this year.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged.

Tuesday, 23rd April

EDINBURGH.—11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. Annual general meeting, followed by a film show.

Wednesday, 24th April

CHESTER.—5, King's Buildings, King Street, 7 p.m. Society of Instrument Technology, Chester Section. Annual general meeting.

HOVE.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. "Practical Applications of Modern Science," by H. E. J. Butler.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Transmission of Electrical Power at 400 kV in the Soviet Union," by S. S. Rokotyan. Presented in English by B. P. Lebedev.

Connaught Rooms, Great Queen Street, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Address by Mr. A. McL. Mooney on "The Size of the Universe."

London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers, London Section. "The Properties of Semiconductor Devices," by A. A. Shepherd.

Manson House, Portland Place, W.1, 7 p.m. Society of Instrument Technology. "Measurement and Control Circuits in the Human Operator," by W. K. Taylor.

Thursday, 25th April

CANTERBURY. — County Hotel, 8 p.m. A.S.E.E. Kent Branch. "The History of Lighting," by J. Roper.

DUBLIN.—28, Merrion Square, 5.30 p.m. I.E.E. Irish Branch. Annual general meeting.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. "138 kV Submarine Power Cable Interconnecting the Mainland of British Columbia to Vancouver Island."

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Institute of Fuel. Annual luncheon.

SHEFFIELD.—Grand Hotel, 7.30 p.m. Incorporated Plant Engineers, Sheffield and District Branch. "Welding Applied to Maintenance," by A. O'Donnell.

Friday, 26th April

ABERYSTWYTH. — University College of Wales, 5.30 p.m. Institute of Physics, South Wales Branch. "Instrumentation of the Liverpool Synchrocyclotron," by Dr. B. Collings.

BATH.—South Western Electricity Board, 7 p.m. I.E.S. Bath and Bristol Centre. Annual general meeting and film show.

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "A Feminine Viewpoint on Domestic Lighting," by Mrs. Kay Hudson.

Imperial Hotel, Temple Street, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch. "Earthing and Earth Leakage Protection," by J. A. Robbins.

EDINBURGH. — The University, 6.30 p.m. British Institution of Radio Engineers, Scottish Section. Annual general meeting followed by "Special Process Instrumentation in Atomic Energy Projects," by H. Bisby.

LONDON.—Cora Hotel, Upper Woburn Place, W.C.1, 9.15 a.m. Institution of Chemical Engineers, Graduate and Student Section. "The Impact of Atomic Energy on Chemical Engineering."

Connaught Rooms, Great Queen Street, Kingsway, W.C.2, 6.45 for 7.15 p.m. Junior Institution of Engineers. Annual dinner.

Saturday, 27th April

OXFORD.—Regents Park College, Pusey Street, 6.30 p.m. A.S.E.E. Oxford, Reading and Districts Branch. "Applications of the Cathode Ray Tube," by C. H. Gardner.

WEMBLEY PARK.—Century Hotel, Forty Avenue. A.S.E.E. North West London Branch. Theatre and supper party.

Saturday, 27th April, to Tuesday, 30th April

EASTBOURNE.—Queen's Hotel. Association of Electrical Machinery Trades. Annual Convention.

Trolley-Buses in Brazil

The *Fortnightly Review* of the Bank of London & South America says that a new company recently formed in Sao Paulo by the Villares group has begun construction of electric trolley-buses which are to be built with 86 per cent of Brazilian labour. More than 800 of these vehicles have been the subject of public tenders and it is stated that Brazil will need a total of 2,400 in the near future. This number of imported trolley-buses would cost $72 million (U.S.) but the operation of the local factory would achieve a saving of $68·5 million.

Financial Section

STOCKS and SHARES

AFTER an interval for reflection on the Budget proposals, a feeling of sober satisfaction persisted in Stock Exchange markets. On that score at least, the House approached the Easter holiday with an easy mind, although still nagged to some extent by other uncertainties outstanding. Early reactions to the Chancellor's measures have been of course most noticeable in the comparatively small field of companies directly affected by them, especially those which seem to qualify for the tax reliefs to overseas trading concerns. The absence of general reductions in company taxation this time left the broad field of industrial shares without any special stimulus, and in some sections the tendency at first was to retrace a part of the considerable advance achieved in the early part of the month. On the whole, however, the tone was distinctly firm.

Electrical Shares

Most of the leading electrical equipment and engineering shares were affected to some extent by the industrial market's mild reaction in the days following the Budget. All the same, share prices remained not very much below the best quotations of the year, which means also in many cases the highest since the Suez trouble first broke in the middle of last summer. Capital issues returned to the news with the announcement of a "rights" issue of new ordinary shares, at 35s, by Westinghouse Brake & Signal. The market is expecting to see English Electric's capital plans before very much longer. Gilt-edged stocks made a very guarded response to the improvement in sterling, being subdued under the impression that events of the past month or two have pushed further into the future the possibility of another step down in Bank Rate.

C. A. Parsons Results

Announcement of the results for 1956 by C. A. Parsons & Co. was followed by a modest advance in the price of the £1 shares to around 68s 6d. The final dividend of $3\frac{3}{4}$ per cent is payable on ordinary capital increased from £3·3 to £9 million, since last year's corresponding payment of $6\frac{1}{4}$ per cent, as a result of the subsequent cash and scrip issues. The interim payment for 1956, applicable to the smaller capital, had been raised from $3\frac{3}{4}$ to $4\frac{3}{4}$ per cent. In terms of money, the company is distributing about £285,000 net, against £207,000 for the previous year. Once again, this represents a highly conservative financial policy, for the dividends absorb no more than one-eighth of the available surplus. Net profit of the group has risen from a little under £2 million to nearly £2·3 million, despite an increase in the tax charge to £1·9 million. A yield of only about 2 per cent on the shares is of course related more to the high rate of earnings than to the current dividend.

Reyrolle Report

In his review accompanying A. Reyrolle's annual report, Sir Claude Gibb draws attention to the fact that the comparison between the 1956 earnings and those of 1955 is modified by the exceptional factors which inflated the earlier figures. During the year under review, output broke the previous record and the value of orders received was also higher than ever before in the firm's experience. So far as trading margins were concerned, the policy of adopting the most modern production methods failed to offset entirely the rise in costs; but although the margin was lower than in recent years it remained satisfactory. Speaking of the company's part in the construction of the Bradwell nuclear power station, the chairman told shareholders that Reyrolles have undertaken the machining of the graphite moderator bricks in addition to supplying switchgear and equipment for the control of reactors. The £1 shares recovered much of the setback which occurred at the time of the preliminary statement of the results at the end of last month, and improved to 105s 6d after the announcement of increased earnings by the associated C. A. Parsons company.

B.I.C.C. Earnings

A fall in the 1956 trading profits of the British Insulated Callender's Cables group from £11·8 to £9·3 million leaves the company with no difficulty in maintaining the dividend for the year at the previous rate of $12\frac{1}{2}$ per cent: this is still covered about three times by the net earnings of £4 million remaining after the deduction of £3·4 million for taxation. Shareholders had been advised at last year's meeting that it would be difficult for the group to escape altogether the effects of reduced expenditure in other spheres and the October interim report had indicated that profits in the first half of the year were down, despite higher turnover. Apparently, however, the extent of the drop in profits was rather larger than had been expected in the market, where the shares were marked down at first by a shilling or so to 52s 3d. They are on a yield basis of 4·9 per cent.

Automatic Telephone Dividend

Automatic Telephone & Electric ordinary shares reacted well to the declaration of the results for 1956, rising initially from 62s to 66s 3d, after touching 68s. In addition to paying the 12 per cent final dividend indicated at the time of last October's issue of new shares (which participate in the distribution) the company has declared an extra 2 per cent in the form of a bonus. With the interim paid before the capital increase, the total payment for the year is 17 per cent (against the previous year's 15 per cent). A similar rate is being paid on the deferred shares. An expansion of the net group profit by a quarter to nearly a million (after taxation of £806,000) accommodates very comfortably the increase in the payments, which appear from the preliminary statement to be covered practically $3\frac{1}{2}$ times over by the distributable earnings. With the inclusion of the bonus in the calculation, the yield on the shares works out at about $5\frac{1}{4}$ per cent.

Market Notes

Lancashire Dynamo £1 shares remained at about 44s after the company's decision to bring the total dividend for the year to 11 per cent (as before), of which the final 7 per cent applies to capital increased by the shares issued in connection with last year's acquisition of the business of J. G. Statter & Co. Net profit for 1956 improved by £36,000 to £620,000, after tax. Watford Electric have also announced a moderate rise in trading profits and the maintenance of dividends at the previous total of 25 per cent, on larger capital. The 2s shares were subsequently unchanged at 6s 6d. Tube Investments $5\frac{1}{4}$ per cent loan stock has remained within a fraction of the issue price of $95\frac{1}{2}$. At the Bylock Electric annual meeting the chairman said that business had increased very substantially since July, the date of the last accounts, and that a further scrip issue was being considered. At 3s 6d the 1s shares yield about $9\frac{1}{2}$ per cent on the basis of the $33\frac{1}{3}$ per cent dividend.

Incorporated Plant Engineers

The annual conference of the Incorporated Plant Engineers will be held from 15th to 17th May at the Palace Hotel, Buxton. The theme of the conference will be "The Plant Engineer's Adapability to Change." Following the presidential address two papers will be presented. Sir Oliver Lyle will give a paper on "The Plant Engineer's Orbit," and Mr. J. F. Coales will read a paper on "The Impact of Automation on the Plant."

In addition there will be group discussions on the following papers:—"Modern Trends in Factory Design and Equipment," by Mr. E. C. Stevens; "The Value of Budgetary Control to the Plant Engineer," by Mr. T. S. Welch; and "Getting the Best from Maintenance Personnel," by Mr. J. C. Veale. The conference dinner will be held on the Thursday evening when the principal speaker will be Mr. J. E. Braham, engineering controller, Imperial Chemical Industries, Ltd.

REPORTS and DIVIDENDS

A. Reyrolle & Co., Ltd.—The main figures in the accounts for 1956 were given in our issue of 5th April. In his circulated statement Sir Claude Gibb (chairman) says that the year under review has been a most active one and the value of orders received is substantially higher than has ever been recorded in the company's history. Although they have continued to reduce costs wherever practicable by adopting modern production techniques, it has not been possible by these means completely to offset rising costs and the trading margin whilst satisfactory is not so high as in recent years.

The Nuclear Power Plant Co., with which they are associated, has secured the contract for the Bradwell nuclear power station for the C.E.A. Last year he reported that the company would supply the equipment for the control of reactors in addition to supplying its standard products of main and auxiliary switchgear. Since then it has also been agreed to undertake the machining of the graphite moderator bricks for each reactor. They, with their associates, C. A. Parsons & Co., Ltd., and two other British companies, joined with the Great Lakes Carbon Corporation of the U.S.A. to form the Anglo Great Lakes Corporation, Ltd., with the object of making graphite in this country. It is intended to undertake manufacture at Newburn-on-Tyne where construction of a new factory has already begun.

The light engineering shop which was under construction last year is now in use. They have decided upon a major extension to one of their shops at the Hebburn Works in order to provide additional space and special facilities for the manufacture of control equipment for the reactors. The test equipment at the research station is being augmented by the installation of a bank of outdoor condensers which will enable them to study and prove the performance of their switchgear under the arduous conditions imposed when switching long overhead transmission lines. Work has been initiated on extensions of the existing laboratories which should be completed in 1958. Recent work of the Research and Design Departments has enabled them to manufacture and to carry out successfully proving tests on the first 11 kV 500 MVA air-break switchgear in this country.

C. A. Parsons & Co., Ltd., report that after providing £1,941,000 for taxation and allocating £15,000 for contingencies, the net profit for 1956 is £2,293,364, as compared with £1,962,613 for 1955. It is proposed to pay a final ordinary dividend on £9,000,000 capital of $3\frac{3}{4}$ per cent. An interim dividend of $4\frac{3}{8}$ per cent was paid on £3,600,000 before a 50 per cent scrip issue and a one-for-one rights issue. The total distribution for 1955 on the smaller capital was 10 per cent.

The Telegraph Condenser Co., Ltd.—The annual meeting will be held on 2nd May. In his circulated statement Mr. D. W. Aldridge (chairman) says that during 1956 the completion of additional manufacturing facilities at the Bathgate works enabled them to expand production of certain of their products, and to relieve congestion which existed in some of the older workshops. Except for a few months during the summer, the productive capacity of both the Acton and Bathgate factories was fully employed. Although there was a small overall reduction in turnover during 1956, the demand for their products in overseas markets did not suffer to any appreciable extent. Since the end of the financial year they have entered into arrangements to commence manufacture of certain types of capacitors in Canada for the purpose of supplementing the range which they currently export to that country, and of improving their service to customers. They have started the current year with a reasonably satisfactory order book.

Parkinson & Cowan, Ltd.—Mr. H. P. Barker (chairman and managing director), in his circulated statement covering the year 1956, says that during the year they decided to consolidate their domestic appliance activities in their Birmingham works and to operate them under a single management. They closed their London factory and transferred all the equipment to Birmingham. They are now carrying out a similar operation in Measurement, Ltd., their division concerned with the manufacture of liquid meters, pumps and electricity meters. This division operated two factories at Oldham and Dobcross, and they are now concentrating their manufactures at Dobcross where they have space to provide for eventual expansion. There was a record turnover during the past year and 1957 has started well.

A. H. Hunt (Capacitors), Ltd.—In his review of 1956 Mr. S. H. Brewell (chairman and managing director) says that during the year a further extension was erected at the New Addington factory. Despite the credit squeeze, which was inclined to upset the balance of their planned production, and the Suez crisis they exceeded their 1955 overall turnover and further improved their export position; the profit margins, however, were lower. The demand for capacitors for all types of electronic, nucleonic and telecommunications equipment is increasing steadily; the only major setback was the disappointment of their Canadian operation. The substantial loss made there was primarily caused by a severe recession in their class of industry, which was further adversely affected by considerable overseas competition, including European and Japanese. The Canadian picture caused them considerable concern during 1956 and discussions are now taking place with their partners, the Canadian Marconi Co., with a view to deciding the future of their "Ajax" operation. The current order book is so far encouraging.

The Telephone & General Trust, Ltd.—In the course of his statement which accompanies the report and accounts for 1956 Sir Alexander Roger (chairman and managing director) says that it is proposed to increase the authorised ordinary capital by £400,000 to a total of £2,000,000 in order that they may be in a position to make further issues if and when necessary. Referring to the West Indies operating companies, Sir Alexander says that the aggregate gross book value of their plant assets amounted to over £6·3 million at the end of 1956. Ten years ago these plant assets amounted to £1,028,000. This large development has been carried out practically entirely with automatic telephone equipment and cable exported from the United Kingdom, and has played an important part in the economic and social progress of those territories. All this requires large sums of money, and the temporary and permanent financing of these companies' capital expenditure programmes is under constant review in London and by the local managements.

Lancashire Dynamo Holdings, Ltd.—The group profit for 1956, before taxation, is £620,387, an increase of £35,833 as compared with the previous year. Taxation absorbs £342,160, and after crediting £23,068, provisions unrequired, the net balance is £301,295 (£285,818), less £451 minority interests and £318 retained by subsidiaries. It is proposed to pay a final ordinary dividend of 7 per cent on £2,176,179 capital as increased by £375,000 for the acquisition of J. G. Statter & Co. An interim dividend of 4 per cent was paid on £1,801,179. The total distribution for 1955 on the smaller capital was 11 per cent.

The Automatic Telephone & Electric Co., Ltd.—The trading profit for 1956 is £1,794,081, as compared with £1,271,629 for the preceding year, and after deducting £805,935 for taxation, there is a net balance of £988,146 (against £785,367). Of this £159,346 is retained in subsidiary companies and the amount attributable to the holding company is £828,800. It is proposed to pay a final ordinary dividend of 12 per cent (same) and a bonus of 2 per cent (nil), making with the interim dividend of 3 per cent on smaller capital 17 per cent for the year (against 15 per cent), and a divi-

FINANCIAL SECTION (*continued*)

dend of 15 per cent (same) and a bonus of 2 per cent (nil) on the deferred stocks. The group carry-forward is £1,017,300, the amount brought in being £890,104.

British Insulated Callender's Cables, Ltd.—The accounts for 1956 show a group trading profit of £9,322,544, as compared with £11,852,852 for 1955, to which is added profit on investments and profit applicable to earlier years, making £9,924,096. After meeting all charges, including £3,464,752 for taxation, there is a net profit of £4,070,246 (against £5,128,161), of which £3,715,631 is attributable to the holding company. To this is added £289,648, reserves of subsidiary companies released on realisation, making £4,005,279. It is proposed to pay a final ordinary dividend of 8½ per cent, making 12½ per cent for the year. A similar distribution was made in 1955, but the interim dividend in that year was paid on smaller capital. The carry-forward is increased by £890,387.

Last December the directors stated that owing to disturbed conditions and increased difficulty of passing on higher costs, it was anticipated that while satisfactory results would be achieved for 1956, they would not reach the record level of 1955.

The British Electric Resistance Co., Ltd., has declared an interim dividend of 5 per cent (unchanged).

The Watford Electric & Manufacturing Co., Ltd., reports a trading profit for 1956 of £112,807, as compared with £102,030 for 1955, and after providing for taxation, a net balance of £49,304 (against £50,199). It is proposed to pay a final dividend of 10 per cent and a bonus of 10 per cent on increased capital, which with the interim of 5 per cent paid on the smaller capital makes 25 per cent for the year, the same as for 1955.

International Combustion Africa, Ltd.—In the course of his speech at the annual meeting held in Johannesburg on 21st March Sir George Usher (chairman) said that it had been decided to close down the works at Port Elizabeth and centralise the management in the Reef area, and arrangements had now been completed for the establishment of new workshops in the Alrode district of Alberton. The unfulfilled orders still stood at a large figure which should ensure reasonably profitable results in the future.

J. & F. Stone Lighting & Radio, Ltd., has declared an interim dividend of 10 per cent. The directors state that whilst they regard the trading results for the nine months to 30th March last as satisfactory, they would prefer that the maintenance of the interim dividend at the same rate as last year on the increased capital should be regarded more as a step towards equalising the interim and final dividends than as an indication that the final dividend will also be maintained at the same rate.

New Companies

Juby & Co., Ltd.—Registered 26th March. Capital £2,000. Electricians, etc. Directors: J. S. Juby and L. B. Juby. Regd. office: 11, Blackfriars Street, King's Lynn.

Western Electrical (Ealing), Ltd.—Registered 27th March. Capital £1,000. Manufacturers, exporters and importers of and dealers in electrical, radio, radar, television, and similar equipment, etc. Directors: H. E. Warner and Mrs. Jean M. Warner. Regd. office: 20, Bloomsbury Square, W.C.1.

Windsor Electronic Components, Ltd.—Registered 27th March. Capital £1,000. Directors: A. E. Howard, A. R. Howard, Doreen Howard and Mary Andrew. Regd. office: 81, Norwood High Street, S.E.27.

A. & V. Electrics, Ltd.—Registered 28th March. Capital £100. Electrical engineers, etc. Directors: V. G. F. Baxter and G. A. Baxter. Regd. office: 49, High Street, Croydon, Surrey.

R. Burnham (Tunstall), Ltd.—Registered 26th March. Capital £2,000. To acquire the business of an electrical engineer and contractor carried on by R. Burnham at Tunstall, Staffs, etc. Directors: R. Burnham and Mildred M. Burnham. Regd. office: 4, Rathbone Street, Tunstall, Stoke-on-Trent.

Meadows Electrical (Neon), Ltd.—Registered 26th March. Capital £1,000. E. Meadows is the first director. Regd. office: 101-3, Baker Street, W.1.

Diva Electric Systems, Ltd.—Registered 14th March. Capital £100. Dealers in and manufacturers of electrical equipment, electrical engineers, etc. Solicitors: Lovell White & King, 1, Serjeants Inn, E.C.4.

H. Barker & Co. (Electricians), Ltd.—Registered 11th March. Capital £1,000. Directors: H. Barker, Mrs. Emily Barker, R. Farnell and Mrs. Edith Farnell. Regd. office: 6, Bower Street, Bradford.

Acoustronic, Ltd.—Registered 28th February. Capital £1,000. Electrical engineers, electrical and electronic appliance contractors, etc. Directors: J. C. Brown, D. A. Robinson and A. Smith. Regd. office: 9, Mansfield Street, W.1.

Jones Radio (Manchester), Ltd.—Registered 28th March. Capital £3,000. Electrical, wireless, electronic and mechanical engineers, etc. Directors: S. Jones (chairman) and May Jones. Regd. office: 3, St. Margaret's Buildings, Bury Old Road, Manchester, 8.

Liquidation

F. H. Wheeler (Sheffield), Ltd.—Winding up voluntarily. Liquidator, Mr. R. L. Davis, 58, Theobald's Road, London, W.C.1, appointed 25th March.

In a circular to its customers, the company states that the winding-up is for the purpose of facilitating the operation of the F. H. Wheeler group of electrical companies, and it will not in any way impair the service which the F. H. Wheeler organisation provides. The management and staff at Sheffield will not in any way be affected as they will operate on behalf of the main company, F. H. Wheeler & Co., Ltd., of 39, Victoria Street, London, S.W.1. The directors of the Sheffield company state that any existing obligations to customers and suppliers will be met in full and all work currently on hand in the name of the company will be completed by it.

Bankruptcies

D. Gillon, 52, Raynel Drive, Adel, Leeds, plumber and electrician.—Public examination 4th June at the County Court House, Albion Place, Leeds, 1.

G. A. Watts, 16, Martin's Road, Stockwell, London, S.W.9, electrical engineer, and **G. H. Watts,** 32, Moat Place, Stockwell, S.W.9, electrician, lately carrying on business under the style of Watts and Watts, at 185, Stockwell Road, Stockwell, London, S.W.9, and 32, Moat Place, Stockwell, S.W.9, electrical engineers.—Trustee, Mr. A. E. Attwood, 20-21, Lawrence Lane, Cheapside, London, E.C.2, released 21st March.

M. W. Scrupps, 8, Yarborough Road, Wyberton, Lincs, electrical engineer, lately trading in partnership with another under the style of M. & R. Scrupps, at 8, Yarborough Road, Wyberton.—Receiving order made 3rd April on debtor's own petition.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 27th April:—

COMET. No. 759,144. Class 7. Machines for washing, mixing, mincing, ironing, drying hair, peeling vegetables and for cleaning vegetables; and centrifugal machines for drying clothes; all being electrically operated and for domestic use. COMET. No. 759,145. Class 9. Bells, bell systems, buzzers, bell transformers, cigar lighters, cigarette lighters, openers for doors, vacuum cleaners, floor polishing machines, floor scrubbing machines, tea infusers, kettles, coffee percolators, casseroles, tea pots, hot water jugs, cooking pots, cooking pans and chimes for doors, all being electrically operated and for domestic use. COMET. No. 759,146. Class 11. Milk boilers, space heaters, pokers, immersion-heating apparatus, toasters, hot plates, refrigerators and hair drying appliances (not machines), all being electrically operated and for domestic use.—Morphy-Richards, Ltd., Arterial Road, St. Mary Cray, Orpington, Kent.

COLASIT. No. 735,667. Class 9. Industrial chemical apparatus and instruments and parts and fittings; electric and electronic apparatus and instruments; and electric welding apparatus.—Colasit A. G., Wimmis, Switzerland. Address for service, c/o Wildbore & Gibbons, 101, Leadenhall Street, London, E.C.3.

TAYLOR. No. 740,697. Class 9. Electric instruments for the indication or measurement of electric current, voltage, resistance, power, capacitance and power factor; and volume indicators, electric oscillation generators, wobbulators, insulation testers, oscilloscopes, circuit analysers and valve testers.—Taylor Electrical Instruments, Ltd., Montrose Avenue, Slough, Bucks.

PAC. No. B758,139. Class 9. Wired electrical circuits.—Erie Resistor, Ltd., 2, Carlisle Road, The Hyde, Hendon, London, N.W.9.

MUSIRAMA. No. 758,239. Class 9. Apparatus for recording and reproducing sound; sound amplifiers, gramophone pick-ups, phonographs, phonograph discs, loudspeakers; and radio receiving and transmitting apparatus.—Paul Pacini, Paris, France. Address for service, c/o Lloyd Wise, Bauly & Haig, 10, New Court, Lincoln's Inn, London, W.C.2.

NUMERI. No. 759,017. Class 9. Electrical devices for use with telephone systems for dialling, transmitting, displaying and recording numbers or symbols.—F. A. Taylor, 81A, Grays Inn Road, London, W.C.2.

FLORAWARM. No. 759,527. Class 9. Electrical instruments and apparatus; and covered electric wire and electric cables.—Wandleside Cable Works, Ltd., 106, Garratt Lane, Wandsworth, London, S.W.18.

EFE (design). No. B760,297. Class 9. Plugs, sockets, switches and switch sockets, all being electrical.—E. F. Electric, Ltd., Willow Lane, Watford, Herts.

ROTOTAST. No. 759,898. Class 9. Electronic apparatus for use in automatically controlling the action of oxygen cutting machines.—Rototast Electronic Controls, Ltd., Hope House, 45, Great Peter Street, London, S.W.1.

DRI-KLO (design). No. 760,885. Class 11. Electrically heated cabinets for drying clothes.—T. Marshall, S. Marshall and D. Marshall, trading as "Dri-Klo," 1A, Sugar Lane, Manchester, 4.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 24th April from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

13002. British Thomson-Houston Co., Ltd.—Ultra-high-frequency pulse receivers. 22nd May, 1952. (773522.)

23273. Müller, J. R.—Coil capacitor and method of and apparatus for producing same. 16th September, 1952. (773144.)

28803. General Electric Co.—Electroluminescent structures. 14th November, 1952. (773311.)

1953

11554. Schöttle, R.—Universal kitchen electric motor driven machines. 27th April, 1953. (773492.)

26526. Simplex Electric Co., Ltd.—Reflectors for electric and other heaters. 10th September, 1954. (773316.) 26527. Electric fires. 10th September, 1954. (773317.)

27488. Electric & Musical Industries, Ltd.—Formation of helical windings. 6th October, 1954. (773496.)

27855. British Thomson-Houston Co., Ltd.—Waveguides. 29th October, 1954. (773527.)

27939. Chilton Aircraft Co., Ltd.—Electrical circuit-breakers. 30th September, 1955. (773193.)

29510. Standard Telephones & Cables, Ltd.—Magnet arrangements for travelling-wave tubes. 26th October, 1953. (773394.)

31551. Communications Patents, Ltd.—Wired broadcasting systems and apparatus for television. 11th February, 1955. (773195.)

1954

2541. Venner, Ltd.—Timing devices. 27th April, 1955. (773498.)

5821. Telefonaktiebolaget L. M. Ericsson.—Apparatus for reading information stored in electronic storage tubes. 26th February, 1954. (773075.) 5822. Apparatus for storing information in electronic tubes. 26th February, 1954. (773076). 16367. Apparatus for electronic storing of information. 2nd June, 1954. (773077).

7810. Jones & Co. (Engineers), Ltd., W.—Governors for dynamo-electric machines. 16th March, 1955. (773501.)

12800. Pye, Ltd.—Waveform generators. 3rd May, 1955. (773200.)

13922. Krebs, T.—Electric spraying pistol. 12th May, 1954. (773367.)

14179. English Electric Co., Ltd.—Liquid resistance controllers. 13th May, 1955. (773201.)

16026. Fielden Electronics, Ltd.—Impedance measuring devices. 29th March, 1955. (773085.)

16267. Electric & Musical Industries, Ltd.—Colour television. 2nd June, 1955. (773203.)

18462. Radio Corporation of America.—Colour television recording and reproducing. 23rd June, 1954. (773204.)

19785. Pye, Ltd.—Television receivers. 28th June, 1955. (773321.)

20734. Telefunken Ges.—Electrostatic deflecting means for cathode-ray tubes. 16th July, 1954. (773368.)

22318. Philips Electrical Industries, Ltd.—Devices for rendering X-ray images visible. 30th July, 1954. (773370.)

23073. Cutler-Hammer, Inc.—Electric switches having casings including actuator openings. 9th August, 1954. (773213.)

23160. Bosch Ges., R.—Circuit-breaker for condensers fitted in housings. 10th August, 1954. (773371.)

23238. Tesla, Narodni Podnik.—Circuit for impulse frequency division. 10th August, 1954. (773214.)

23350. General Electric Co., Ltd.—Refrigerators. 9th August, 1955. (773215.)

24189. M-O Valve Co., Ltd., and Windsor, L. R. E.—Thermionic cathode cores. 17th August, 1955. (773372.)

24276. Plessey Co., Ltd.—Electromagnetic induction devices. 15th August, 1955. (773218.)

24726. Metropolitan-Vickers Electrical Co., Ltd.—Electrical pulse generators. 12th September, 1955. (773221.)

24842. General Laboratory Associates, Inc.—Electric discharge devices and circuits thereof. 26th August, 1954. (773222.)

25482. Marconi's Wireless Telegraph Co., Ltd.—Variable inductance devices. 10th June, 1955. (773223.)

25932. Metropolitan-Vickers Electrical Co., Ltd.—Electrical pulse generating circuit arrangements. 5th September, 1955. (773224.)

26230. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 28th June, 1955. (773374.)

27302. General Electric Co., Ltd.—Methods of sealing a metal contact element into a glass wall. 5th September, 1955. (773226.)

28060. Belling & Lee, Ltd.—Electric fuse link and a method of making same. 24th November, 1955. (773376.)

28291. Birlec, Ltd.—Electric cremation furnaces. 3rd October, 1955. (773358.)

28357. General Electric Co., Ltd.—Resonant coupling circuits. 30th September, 1955. (773548.)

28710. Radio Corporation of America.—Electron lens. 5th October, 1954. (773377.)

28790. Philips Electrical Industries, Ltd.—Television systems. 6th October, 1954. (773078). 29363. Line-sequential colour television systems. 12th October, 1954. (773079). 32711. Devices for producing multiplex television signals. 11th November, 1954. (773380).

32843. General Electric Co.—Coil winding machines for electric motors and the like. 12th November, 1954. (773517.)

32905. Collins Radio Co.—Angular adjustment circuit for electromagnetic resolver. 12th November, 1954. (773382.)

36874. Marconi's Wireless Telegraph Co., Ltd.—Goniometers. 26th August, 1955. (773235.)

37000. Chromatic Television Laboratories, Inc.—Target structures for use in colour television tubes. 22nd December, 1954. (773339.)

37844. Rochar Eléctronique.—Electronic amplifiers. 31st December, 1954. (773383.)

1955

15. Dorman & Smith, Ltd.—Fixing of miniature electric circuit-breakers. 19th December, 1955. (773341.)

681. Felten & Guilleaume Carlswerk Akt.-Ges.—Two-directional amplifier. 10th January, 1955. (773093.)

987. Associated Electrical Industries, Ltd.—Apparatus for indicating small movements. 4th January, 1956. (773238.)

1965. Siemens & Halske Akt.-Ges.—Arrangements for compensating for axial astigmatism in electron lenses. 21st January, 1955. (773240.)

2542. British Insulated Callender's Cables, Ltd.—Manufacture of electric cables. 26th January, 1956. (Cognate application 37167, 28th December, 1955.) (773563.)

3284. Simplex Electric Co., Ltd.—Wall boxes for electric switches. 2nd February, 1956. (773564.)

5188. Telefonaktiebolaget L. M. Ericsson.—Coaxial cable devices for transmission of electric energy having a wide frequency range. 21st February, 1955. (773244.)

6310. Philips Electrical Industries, Ltd.—Mounting a cathode-ray tube in a support. 3rd March, 1955. (773384.)

6646. Stichting voor Fundamenteel Onderzoek der Materie.—Nuclear reactor and reactor tube therefor. 7th March, 1955. (773343.)

8015. General Electric Co.—Transparent films which are electrically conducting. 18th March, 1955. (773312.)

9289. General Electric Co.—Composite ceramic-metal bodies. 30th March, 1955. (773424.)

11138. General Electric Co.—Electric current limiting arrangements, particularly for commutating contact rectifiers. 18th April, 1955. (773345.)

12155. Western Electric Co., Inc.—Magnetic switching circuits. 27th April, 1955. (773165.)

13190. Philips Electrical Industries, Ltd.—Circuit arrangement comprising a detector and a transistor. 6th May, 1955. (773385.) 16168. Transistor push-pull modulators. 6th June, 1955. (773435.)

13517. Philips Electrical Industries, Ltd.—Multiplex transmission systems for television and like signals. 10th May, 1955. (773251.)

13902. Emag Elektrizitäts-Ges.—High speed electrical disconnecting devices. 13th May, 1955. (773386.)

14446. Lockers (Engineers), Ltd.—Means for generating pulsating direct currents. 15th November, 1955. (773252.)

15396. Machlett Laboratories, Inc.—Thyratron structure. 27th May, 1955. (773253.)

16750. Philips Electrical Industries, Ltd.—Radio communication systems. 10th June, 1955. (773170.)

17381. International Business Machines Corporation.—Synchronous motor secondary clock. 16th June, 1955. (773389.)

18037. Compagnie Industrielle des Téléphones.—Translating device for telegraph system comprising a two-wire line used for both directions of transmission. 22nd June, 1955. (773106.)

23036. Hartmann & Braun, Akt.-Ges.—Pulse echo fault locator. 10th August, 1955. (773466.)

23317. General Electric Co.—Electrical insulating material. 12th August, 1955. (773282.)

23600. Philips Electrical Industries, Ltd.—Detector circuit arrangements. 16th August, 1955. (773470.)

25267. General Motors Corporation.—Electrical connector. 2nd September, 1955. (773473.)

26298. Vogt, A.—Induction furnaces operating in a rarefied atmosphere. 14th September, 1955. (772932.)

26757. Moulon, J. M.—Negative impedance repeaters for loaded cables. 19th September, 1955. (772994.)

28347. Pirelli Soc. Per Azioni.—Manufacture of flexible and extensible cords for telephone or other electrical purposes. 5th October, 1955. (773043.)

28618. Standard Telephones & Cables, Ltd.—Method of winding grid electrodes. 7th October, 1955. (773044.)

29964. Square D Co.—Saturable reactor control for a polyphase motor. 20th October, 1955. (773135.)

32846. General Electric Co.—Lighting arrangements for refrigerator storage compartments. 16th November, 1955. (772945.)

33059. Westinghouse Electric International Co.—Electrically insulating bushings. 18th November, 1955. (773066.)

34434. General Electric Co.—Aligning of slotted laminations. 1st December, 1955. (772948.)

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10566. General Motors Corporation.—Electric cooker range. 28th February, 1955. (Divided out of 772793.) (772794.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—Snowy Mountains Hydro-Electric Authority. 9th May. Insulators, clamps and bushings. (E.S.B. 9152/57. Ten/25245.)*

Sydney County Council. 2nd May. Outdoor h.v. metering units. (E.S.B. 9151/57. Ten/25270.)*

Birmingham.—City Council. 30th April. Street lighting equipment. (See this issue.)

Transport Committee. 15th May. Electrically operated garage steel roller shutter doors. (See this issue.)

Brazil.—Comissao Estadual de Energia Electrica, Edificio Novo da Prefectura. 9th May. Aluminium and galvanised steel cables. (E.S.B. 8606/57. Ten/25189.)*

Burma.—Burma Purchase Board, Rangoon. 24th April. 23 portable electric drilling machines. (E.S.B. 9655/57. Ten/25330.)*

Cheltenham.—Corporation. 13th May. Street lighting equipment. (See this issue.)

Eastleigh.—Corporation. 3rd June. Street lighting equipment. (See this issue.)

Formosa.—Central Trust of China, Taipei. 11th May. Steam raising plant and mechanical dust collector. (E.S.B. 9224/57.I.C.A. Ten/25223.)*

India.—Bombay Electricity Board. 29th April. 500 kW diesel alternator set. (See this issue.)

Kendal.—Corporation. 15th June. Street lighting equipment. (See this issue.)

Malta.—Maltese Government. 23rd May. Turbo-alternators and ancillary equipment and steam generating plant for Malta power station. (See this issue.)

Meriden.—R.D.C. 6th May. Street lighting equipment. (See this issue.)

New Zealand.—Wellington Corporation. 30th April. Polyphase watthour meters. (E.S.B. 9169/57. Ten/25292.)*

G.P.O., Wellington. 6th May. Battery electric and diesel engine lift trucks. (E.S.B. 9010/57. Ten/25231.)* 27th May. Radio terminal equipment. (E.S.B. 9165/57. Ten/25311.)*

Norway. — Forsvareto Anleggsdirektorat, Oslo. Equipment for a radar station. (E.S.B. 9512/57. Ten/25293.)*

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. Electrical equipment, including armoured cable, junction boxes, insulators, copper conductors and wire, table and wall telephone apparatus and batteries. (E.S.B. 8998/57. Ten/25254.)*

Rhodesia and Nyasaland.—Federal Tender Board, Causeway. 26th April. Insulator spindles. (E.S.B. 9472/57. Ten/25279.)* Tinned copper wire. (E.S.B. 9473/57. Ten/25278.)*

South Africa.—Union Tender and Supplies Board, Pretoria. 25th April. Electric furnace. (E.S.B. 8955/57. Ten/25202.)* Drawer type oven. (E.S.B. 8951/57. Ten/25209.)* 16th May. Telephone switchboards. (E.S.B. 8728/57. Ten/25201.)* Cable locators. (E.S.B. 8605/57. Ten/25192.)* 13th June. Telephone switchboards. (E.S.B. 8727/57. Ten/25248.)*

Johannesburg City Council. 29th April. Glass refractor bowls and screw lampholders. (E.S.B. 9295/57. Ten/25291.)*

Thailand.—Royal Irrigation Department, Bangkok. 10th May. Lighting equipment, cables and accessories. (E.S.B. 9405/57. Ten/25309.)*

United States.—Department of the Interior, Bonneville Power Administration, Portland, Oregon. Conductors and accessories. (E.S.B. 8427/57. Ten/25324.)*

Uruguay.—Ministerio de Salud Publica. 14th May. X-ray apparatus. (E.S.B. 8857/57. Ten/25234.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

London.—L.C.C. Renewal and improvement of the electrical installation in the old building of Sydenham County Secondary School, Dartmouth Road, Lewisham (£5,514) and at Harry Gosling County Primary School, Stepney (£3,520).—Buchanan & Curwen.

Stockton-on-Tees.—Corporation. Electrical work in connection with the erection of 88 houses and 16 bungalows on the Hardwick estate (£2,921).—A. Rose.

Thornaby-on-Tees.—Corporation. Street lighting equipment in Mandale Road and Middlesbrough Road:—Concrete lighting columns (£1,120).—Concrete Utilities. Lanterns and auxiliary gear (£960).—Wardle Engineering Co. Cable, etc. (£2,997).—Treforest Electrical Services.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Accrington.—Factory extension, Birtwistle Street; Mastabar Mining Equipment Co., Ltd., Avenue Parade.

Barnsley.—Fire service headquarters, Broadway; Rex Procter, architect and surveyor, 15, Blenheim Terrace, Leeds, 2.

Barrow-in-Furness.—Welfare home; Poole & Dock, architects, Brazennose Street, Manchester, 2.

Basingstoke.—Houses (51), Hackwood Road; borough architect, Municipal Buildings.

Bath.—Science wing, Kingswood School; W. A. Forsyth & Partners, architects, 47, Nottingham Place, London, W.1.

Birmingham.—Chemistry building for University; Playne & Lacey, architects, 19, Queen Anne's Gate, London, S.W.1.

Warehouse, offices and showrooms, Hurst Street; J. Seymour Harris & Partners, architects, 4, Greenfield Crescent.

Blackburn.—Houses (196), as development of estate adjoining Queen's Park; C. S. Robinson, town clerk, Town Hall.

Boldon.—Private housing estate, Boldon Lane, Cleadon; William Leech, Ltd., builders, St. James Street, Newcastle-on-Tyne.

Bradford.—Residential establishment on site adjacent to Shirley Manor, Wyke (£65,900); W. Clifford Brown, city architect.

Brighton. — Group laundry, Brighton General Hospital; Stanley Roth, Tetley & Felce, architects, 60, West Street.

Cambridgeshire.—Village colleges on sites at Comberton and Melbourn; county architect, Shire Hall, Castle Hill, Cambridge.

Cheltenham.—Houses (65) at Shurdington; Rainger, Rogers & Smithson, architects to R.D.C., Wellington Square, Cheltenham.

Coleraine.—Factory for Ballantyne Sportswear Co., Ltd.; J. Kennedy & Co., Ltd., builders, Society Street.

Darlington.—Additions, East Haven Hospital; borough architect.

Four primary schools, one secondary school and extensions, St. Thomas's R.C. School; borough architect.

Bus station and depot at Feethams; A. Briggs, United Automobile Services, Darlington.

Ealing.—Dwellings (122), Northolt Park estate; borough engineer.

Falkirk.—New works and offices, Glasgow Road, Camelon (£155,000); W. Alexander & Co., Ltd., coach builders, Drip Road, Stirling.

Huddersfield.—Houses (120), Fernside estate (£157,056); borough architect, High Street Buildings.

Liverpool.—Cancer research unit (£250,000) for Regional Hospital Board; regional engineer, 2, Union Street, Liverpool.

Llanelly. — Houses (300), Cynheidre Colliery; housing architect, 12, Station Road.

London. — Fourteen-storey car parking garage, Minories; City of London Real Property Co., Ltd., 16, Mark Lane, E.C.3.

Dwellings (445), Camberwell House estate; borough architect, Camberwell.

Printing works and offices, Holborn; Daily Mirror Newspapers, Ltd., Fetter Lane, E.C.4.

Works extensions; Gestetner, Ltd., Fawley Road, N.17.

Reconstruction of Blue Cross Animals Hospital, Hugh Street; F. R. Morgan, Ltd., builders, 96a, Highgate Road, N.W.5.

Offices, Coldharbour Lane, Camberwell; Western Counties Estates, Ltd., 50, Pall Mall, S.W.1.

Offices, New Bridge Street; John Mowlem & Co., Ltd., builders, 91, Ebury Bridge Road, S.W.1.

Office block, St. Martin's Lane; Griggs & Son, Ltd., builders, 56, Victoria Street, S.W.1.

Maternity, child welfare and school treatment centres at Hallfield, Paddington; Fry Drew, Drake & Lasdun, architects, 63, Gloucester Place, W.1.

Midhurst.—Houses (92), Nappers Wood, Fernhurst; T. Greenfield, architect to R.D.C., Newstead, Midhurst, Sussex.

Newhouse (Lanarkshire). — Factory (£300,000); Scottish Industrial Estates, Ltd., 3, Woodside Place, Glasgow.

Penybont.—Houses (127), Pyle Inn site; R.D.C. surveyor, Coity Road, Bridgend, Glam.

Peterborough.—Dwellings (280), Bluebell estate; city surveyor.

Peterlee.—Houses (135), Acre Rigg; W. J. Scott, chief architect, Peterlee Development Corporation, Shotton Hall, Castle Eden.

Port Sunlight.—Extensions to research wing of Unilever, Ltd.; John Laing & Son, Ltd., builders, Dalston Road, Carlisle.

Seaham.—Houses (134) to replace temporary houses; U.D.C. surveyor.

South Shields.—Additions to Town Hall (£100,000); borough engineer.

Walthamstow.—Flats (33), Chingford Road; A. R. Sheppard, Ltd., building contractors, Maybank Works, Maybank Road, London, E.18.

Warrington.—Reorganisation of kitchen at Winwick Hospital (£43,700), for Liverpool Regional Hospital Board; regional engineer, 2, Union Street, Liverpool, 3.

Wisbech.—Horticultural station buildings (£40,000), for Isle of Ely C.C.; R. D. Robson, county architect, County Hall, March, Cambs.

Wood Green. — Four-storey building, Bounds Green Road, for Dottridge Bros., Ltd.; Vincent Burr & Partners, architects, 85, Gower Street, London, W.C.1.

Woodstock.—Six-storey flats, New Road; Harry W. Smith & Son, architects, 29, George Street.

Worcester.—Showrooms, Evesham Street; Montague Burton, Ltd., Hudson Road Mills, Leeds, 9.

Yorks (West Riding).—Three occupation centres at Castleford, Adwick-le-Street and Wath-on-Dearne; H. Bennett, county architect, Bishopgarth, Westfield Road, Wakefield.